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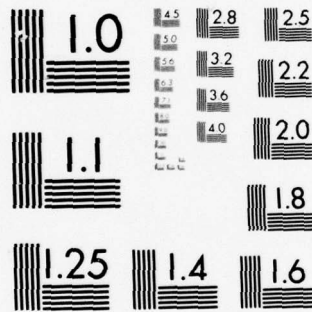
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VESSEL TRAFFIC DATA

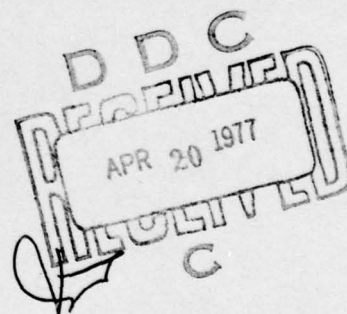
Chesapeake Bay Area

L. Buhler, J. Staley, T. Nightengale, C. Cason, P. Walcott



NOVEMBER 1975

FINAL REPORT



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UNITED STATES COAST GUARD
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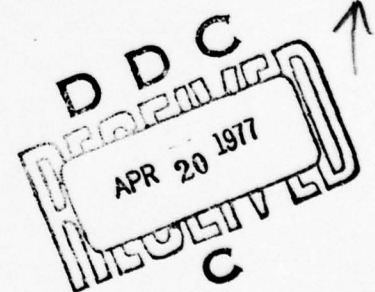
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16. Abstract This report presents data concerning vessel traffic in the Chesapeake Bay Area. The data was obtained from films of a radar PPI at six sites in the Chesapeake Bay Area. Also, tapes of communications activity on Channel 13 of the VHF/FM Maritime Mobile Band provided data. Data analysis obtained the following: Vessel Density; Vessel Route Identification; Vessel Speed; Close Encounter; Message Activity, Channel Utilization; and Channel Efficiency.		
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VESSEL TRAFFIC DATA
FOR
CHESAPEAKE BAY AREA

FINAL REPORT

L.BUHLER, J.STALEY, T.NIGHTENGALE, C.CASON, P.WALCOTT

NOVEMBER 1975

PREPARED UNDER CONTRACT DOT-CG-31446-A, TASK 14
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The authors wish to acknowledge the contribution to the data analysis effort made by the U. S. Coast Guard R&D Center. Early in the effort it was discovered that to obtain significant amounts of communications data would require a considerable amount of time in terms of man-hours. Presented with this problem, the R&D center, in notably minimum time, developed an automated system for extracting data from communications tapes. With this system, the cost of obtaining communications data was significantly reduced. Finally, a comment on the radar films and communications tapes is in order. The films and tapes provided by the R&D center were consistently high quality, thereby easing the problem of data extraction.

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EXECUTIVE SUMMARY

This report is a final report in accordance with Contract DOT-CG-31446-A, Task 14, "VTS Statistical Data Analysis." As per the above contract, this report constitutes the fourth in a series of final reports for selected port areas in the United States.

In the report, data concerning vessel traffic in the Chesapeake Bay area are presented. The data were obtained using the USCG Data Collection Van at six sites throughout the Bay area. The Data Collection Van is equipped with a radar to monitor vessel movements and a communications receiver to monitor communications activity. The location of each of the six van sites is shown in Figure E-1. Specific data contained in the report is as follows:

RADAR

- Vessel Density - A count of the vessels present at a particular time for the data collection radar site. The count is made at regular time intervals. The data is presented in the form of a histogram. Also, vessels are classified as being very small, small, medium, large, at anchor, tugs with tow, or dredges according to the size and behavior of the radar return.
- Vessel Route Identification - A chart depicting the routes used by vessels transiting the area.
- Vessel Speed - A histogram and table of vessel speeds observed at the radar site and tabulations of associated data.
- Close Encounter - A count of vessel encounters and close encounters observed, using close encounter criteria derived in this report.

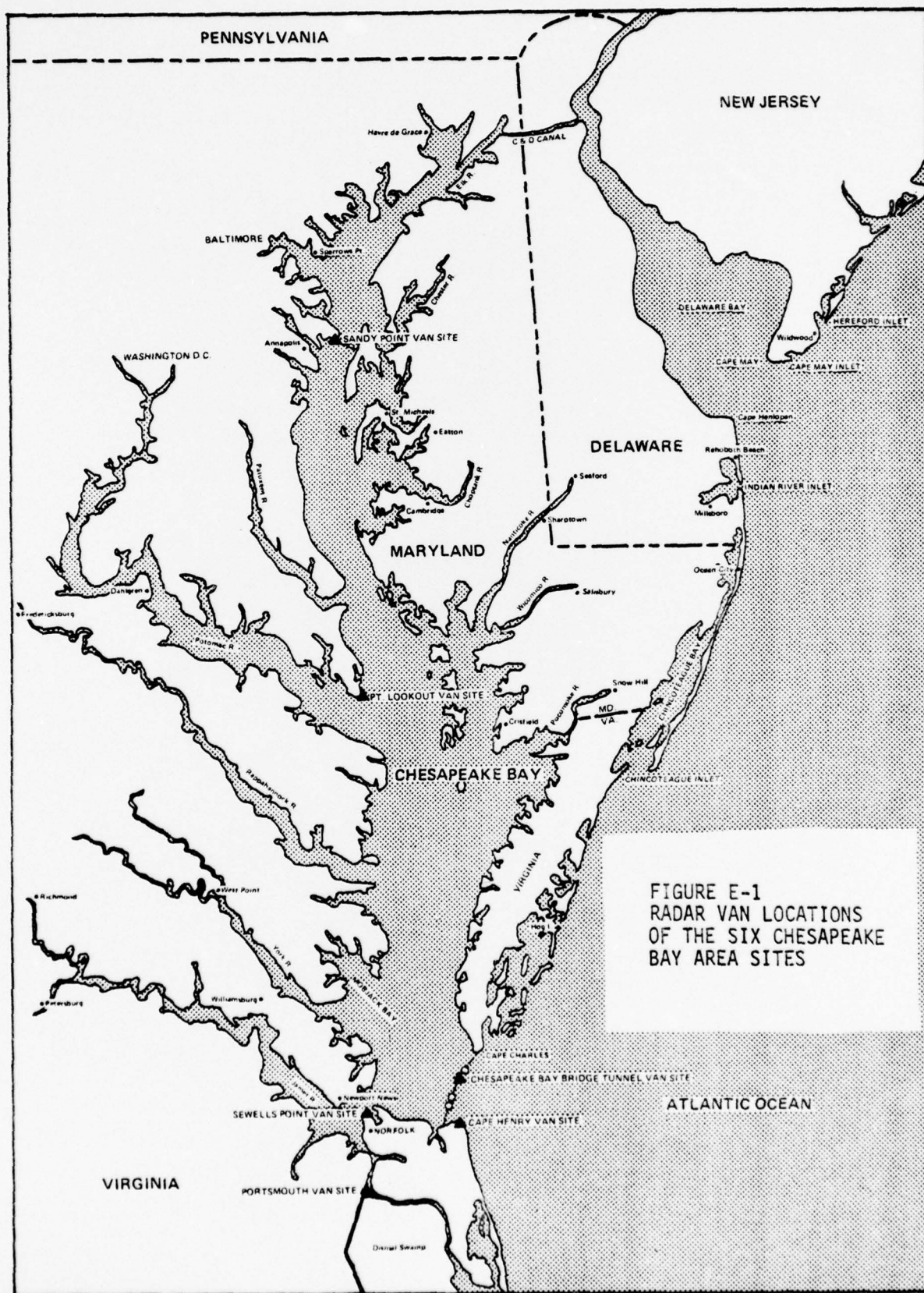


FIGURE E-1
RADAR VAN LOCATIONS
OF THE SIX CHESAPEAKE
BAY AREA SITES

COMMUNICATIONS

- Communications Channel Message Activity - A count of the number of messages transmitted on channel 13 of the VHF/FM Maritime Mobile Band, as a function of time. The data is presented in the form of a histogram with message counts totaled in selected fifteen-minute time intervals over a 24-hour period.
- Communications Channel Utilization - The percentage of time that squelch is broken on channel 13. Utilization is computed for fifteen-minute intervals over a 24-hour period so that the variation in utilization with time of day can be observed.
- Communications Channel Efficiency - A count of the number of valid and invalid messages on channel 13 of the VHF/FM Maritime Mobile Band. Valid messages are those judged to be conforming to the Bridge-to-Bridge Radiotelephone Act. Counts are totaled within fifteen-minute intervals and a histogram of the ratio of valid messages to total messages is given. The abscissa of the histogram is time of day.

The vessel traffic data presented in the report was obtained by analyzing motion pictures of a radar PPI display. Communications data was obtained by monitoring tape recordings of the communications activity on channel 13. The radar films and communications tapes were obtained by the U.S. Coast Guard Data Collection Van. In the Chesapeake area, the van was stationed at six separate locations so that various significant activities could be studied.

The data obtained for this area is given in Section 2 of this report and is organized according to the location of the van.

General Observations on Chesapeake Bay Area

In reviewing all of the Chesapeake Bay Area data given in Section 2, certain conclusions and observations can be made. These are as follows:

1. Vessel Density

- The highest single vessel density count of the six Chesapeake sites occurred at Sewells Point. At 1400 on Saturday, 17 August 1974, 52 vessels were observed.
- A peak traffic period was defined as a time interval during which vessel density is greater than or equal to 50% of the peak value for the site, and is sustained for more than fifteen minutes. Using this definition, the following peak periods were observed:

- Cape Henry - (For radar coverage of Tuesday through Tuesday, 6 - 13 August 1974)
 - Tuesday - 1100 - 1130
 - Wednesday - no peak periods
 - Thursday - 0815 - 1015, 1100 - 1200 and 1330 - 1430
 - Friday - 0830 - 0900 and 0930 - 1045
 - Saturday - 2145 - 2315
 - Sunday - no peak periods
 - Monday - 1500 - 1615 and 1930 - 2215
 - Tuesday - 0430 - 0530

- Chesapeake Bay Bridge and Tunnel - (For radar coverage of Thursday through Thursday, 22 - 29 August, 1974)
 - Thursday - no peak periods
 - Friday - no peak periods
 - Saturday - 1400 - 1515 and 1545 - 1715
 - Sunday - no peak periods
 - Monday - no peak periods
 - Tuesday - no peak periods
 - Wednesday - 1030 - 1330
 - Thursday - no peak periods

- Sewell's Point (For radar coverage of Wednesday through Wednesday, 14 - 21 August, 1974)
 - Wednesday - 1000 - 1045, 1230 - 1430, 1515 - 1545 and 1845 - 2000
 - Thursday - no peak periods
 - Friday - no peak periods
 - Saturday - 1230 - 1300 and 1400 - 1445
 - Sunday - 1100 - 1130, 1215 - 1315 and 1515 - 1945
 - Monday - no peak periods
 - Tuesday - no peak periods
 - Wednesday - no peak periods

- Portsmouth (For radar coverage of Friday through Friday, 30 August - 6 September, 1974)
 - Wednesday - 0945 - 1015
 - All other days, no peak period

- Point Lookout (For radar coverage of Sunday through Sunday, 8 - 15 September, 1974)
 - Thursday - 0100 - 0145
 - Friday - 0800 - 0845, 0930 - 1000 and 1500 - 1630
 - All other days, no peak periods

- Sandy Point (For radar coverage of Monday through Thursday, 16 - 19 September 1974)
 - Monday - 1400 - 1515
 - Tuesday - 0630 - 1945
 - Wednesday - 1030 - 1200 and 1415 - 1715
 - Thursday - no peak periods

- Hourly patterns or cycles in traffic density are evident only to a very limited extent. The data indicates that clear-cut cycling is the exception, rather than the rule.

2. Route Identification. Vessel traffic observed at the six sites of the Chesapeake Bay area was influenced by the nature of the site through which it passed. Tracing the actual routes followed by the vessels revealed the following:

- At Cape Henry and Chesapeake Bay Bridge and Tunnel sites, all large and medium vessels, and most other vessels, stayed strictly within channels. Local activity was of minor importance at these sites.
- Sewells Point traffic was generally passing through the site, with an average of 12 vessels at anchor.
- Portsmouth traffic, while constricted by confined waterways, shows a variety of patterns. This is due, in the main, to the high percentage of local traffic resulting from varied local activities.
- Point Lookout and Sandy Point route identifications show a predominance of through traffic, using either channels or the open waters of the Bay, while local traffic appears to be generally of the recreational variety.

Section 1.7 of this report gives detailed information concerning the types of vessels, predominant direction of advance, and route breakdowns when applicable for each site.

3. Vessel Speed. Observed speeds at Chesapeake Bay had the following ranges:

- | | |
|------------------------------------|--------------------------------|
| • Cape Henry | 4-30 knots (12.4 knot average) |
| • Chesapeake Bay Bridge and Tunnel | 5-22 knots (13.3 knot average) |
| • Sewells Point | 4-19 knots (10.1 knot average) |
| • Portsmouth | 3-12 knots (7.2 knot average) |
| • Point Lookout | 3-20 knots (11.4 knot average) |
| • Sandy Point | 3-19 knots (9.6 knot average) |

More detailed information concerning vessel speeds according to types of vessels is given in Section 1.7 of this report.

4. Close Encounters. The observed rates of close encounter are as follows:

- Cape Henry - 37 in 23 hours (1.6)
- Chesapeake Bay Bridge and Tunnel - 48 in ½ hour (96)
- Sewells Point - 50 in 2½ hours (20)
- Portsmouth - 33 in 2½ hours (13.2)
- Point Lookout - 20 in 24 hours (0.8)
- Sandy Point - 47 in 2 hours (23.5)

The numbers in parentheses were obtained by dividing the number of hours into the number of encounters (i.e. number of encounters per hour).

In observing close encounters, account was taken of encounters which were not "close". That is, an encounter was called a close encounter if the distance between two vessels was below a certain threshold value. This threshold value varied from site to site as a factor of the radar range scale at the site and were as follows: Cape Henry - 300 yards, Chesapeake Bay Bridge and Tunnel - 300 yards, Sewells Point - 200 yards, Portsmouth - 150 yards, Point Lookout - 400 yards, and Sandy Point - 300 yards. The relationship between encounters and close encounters was as follows:

- Cape Henry - 37 close encounters
out of 76 total encounters (49)
- Chesapeake Bay Bridge and Tunnel - 48 close encounters
out of 85 total encounters (56)
- Sewells Point - 50 close encounters
out of 161 total encounters (31)
- Portsmouth - 33 close encounters
out of 42 total encounters (79)
- Point Lookout - 20 close encounters
out of 100 total encounters (20)
- Sandy Point - 47 close encounters
out of 92 total encounters (51)

where the number in parentheses represents the percentage of close to total encounters. More detailed information regarding close encounters is given in Section 1.7 of this report.

5. Channel Utilization. Channel 13 utilization exhibited the following peak and average percentages:

	<u>Day of Coverage</u>	<u>Peak (%)</u>	<u>Time of Peak</u>	<u>Average (%)</u>
Cape Henry	Wednesday, 7 August, 1974	42	1415 - 1430	11
Chesapeake Bay Bridge and Tunnel	Friday, 23 August, 1974	88	2245 - 2300	10
Sewells Point	Friday, 16 August, 1974	53	0945 - 1000	19
Portsmouth	Thursday, 5 September, 1974	81	2315 - 2330	16
Point Lookout	Wednesday, 11 September, 1974	31	0145 - 0200	9
Sandy Point	Tuesday, 17 September, 1974	75	2330 - 2345	14

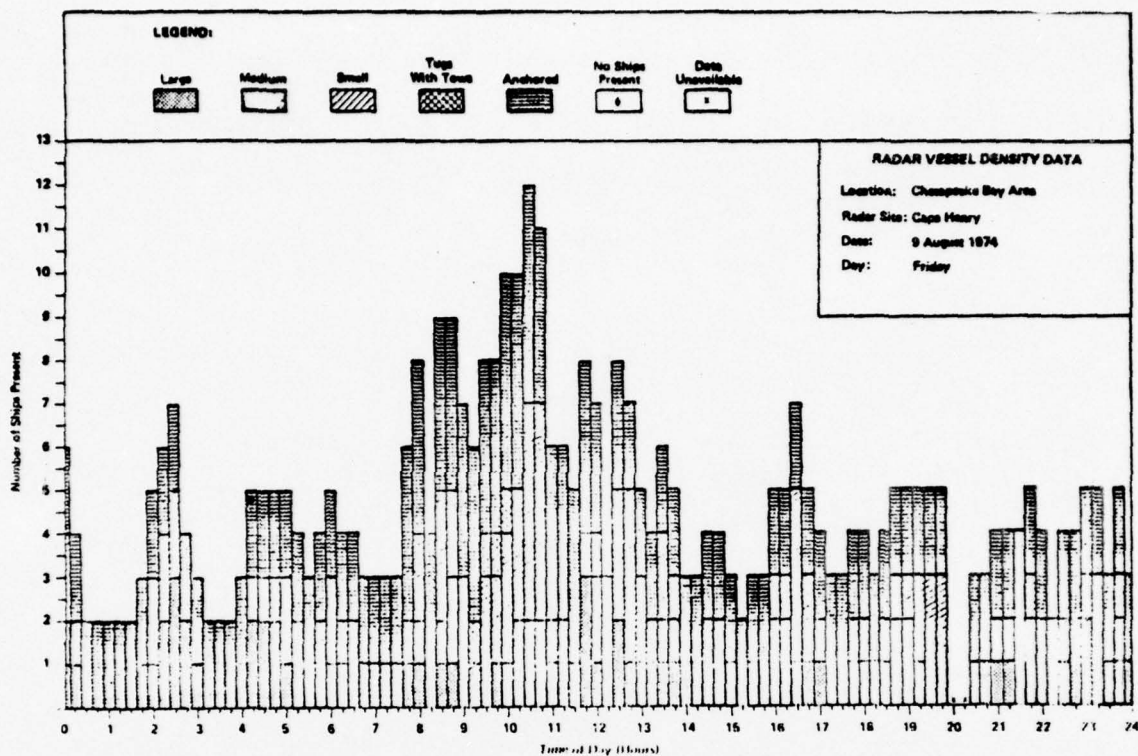
6. Message Activity. Message activity exhibited the following peak and average values for Channel 13:

	<u>Day of Coverage</u>	Peak No. of Messages	<u>Time of Peak</u>	<u>Average No. of Messages</u>
Cape Henry	Wednesday, 7 August 1974	127	0215 - 0230	46
Chesapeake Bay Bridge and Tunnel	Friday, 23 August 1974	316	1430 - 1445	65
Sewells Point	Friday, 16 August 1974	250	0915 - 0930	64
Portsmouth	Thursday, 5 September 1974	222	1815 - 1830	84
Point Lookout	Wednesday, 11 September 1974	163	0415 - 0430	36
Sandy Point	Tuesday, 17 September 1974	213	2115 - 2130	56

7. Channel Efficiency. Channel efficiency data are as follows:

	<u>Peak (%)</u>	<u>Average (%)</u>
Cape Henry	93	34
Chesapeake Bay Bridge and Tunnel	85	41
Sewells Point	100	51
Portsmouth	74	35
Point Lookout	83	43
Sandy Point	89	50

A sample of the form in which each of the various types of data is presented is given in Figure E-2.



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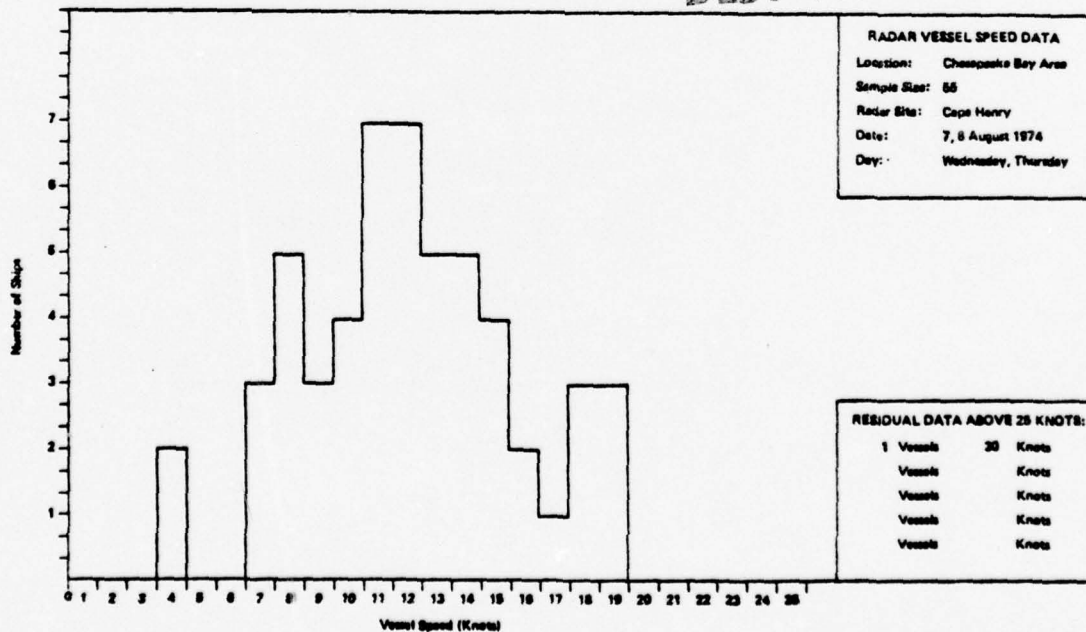


FIGURE E-2 SAMPLE DATA

CLOSE ENCOUNTER DATA
FOR
CAPE HENRY

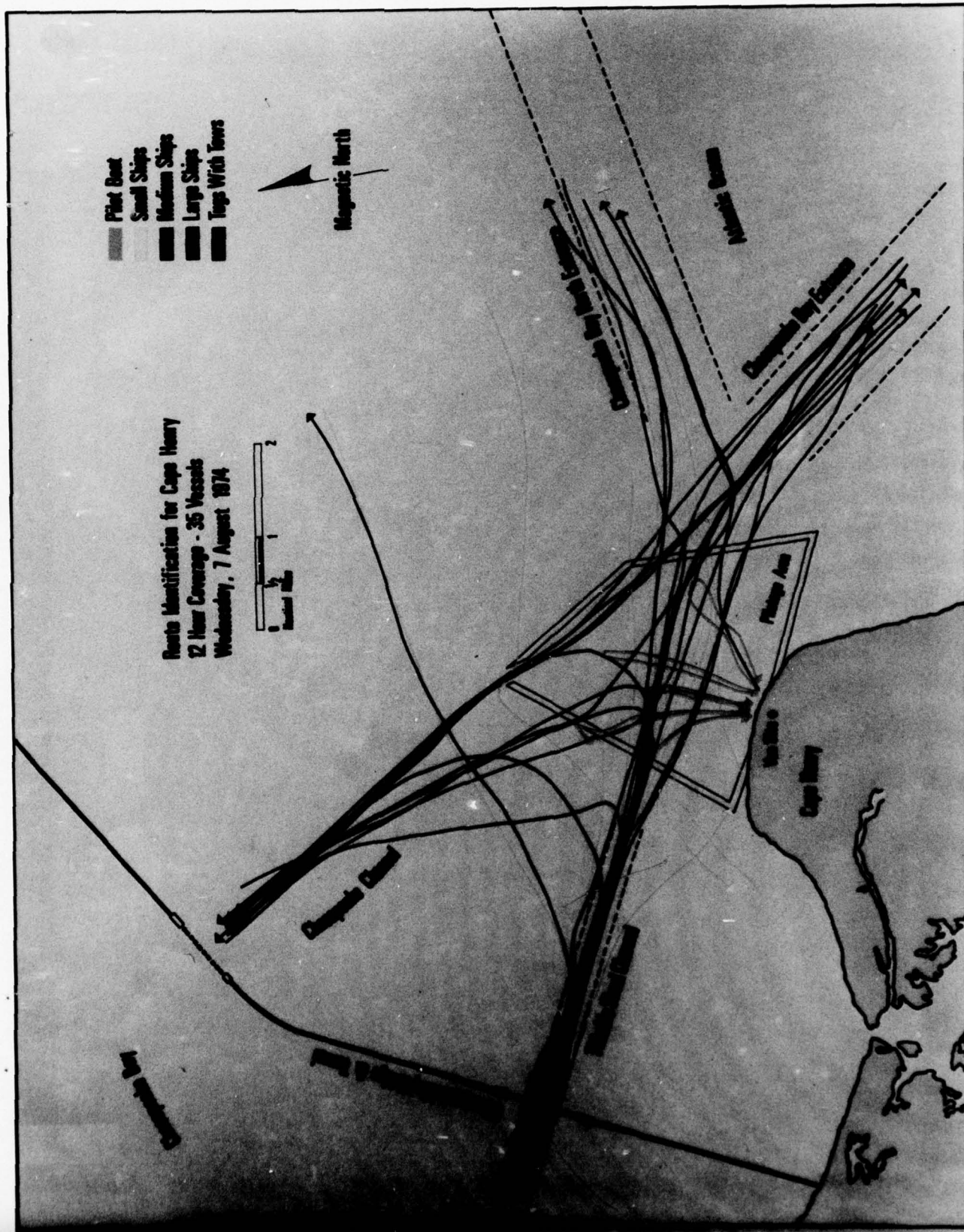
SPEED DATA
FOR
CAPE HENRY

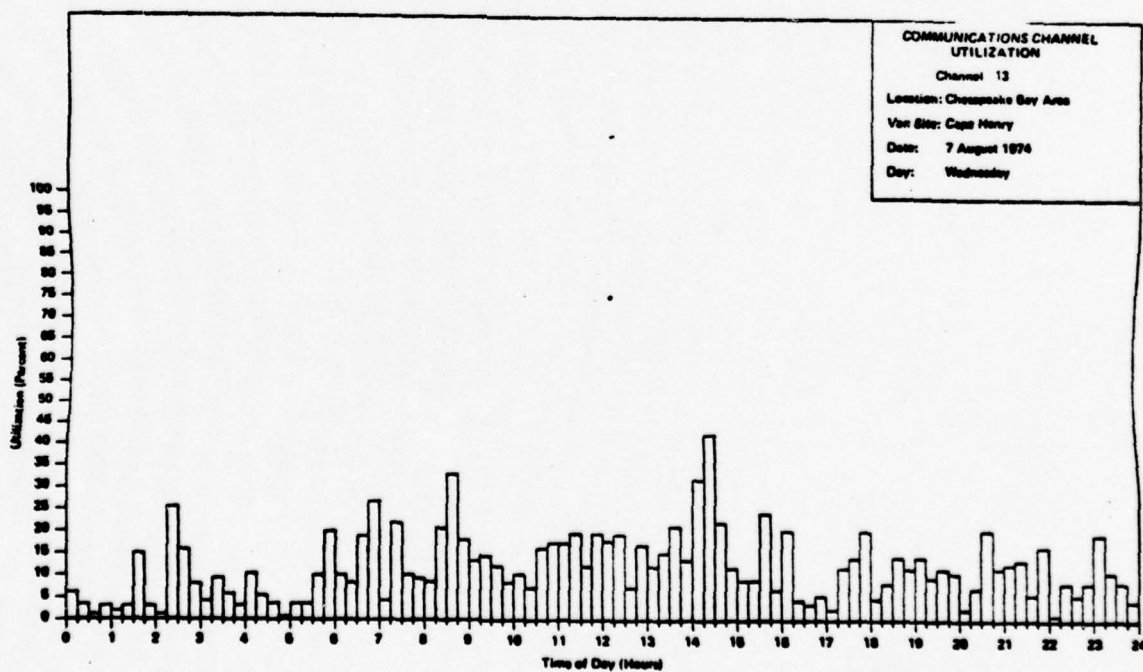
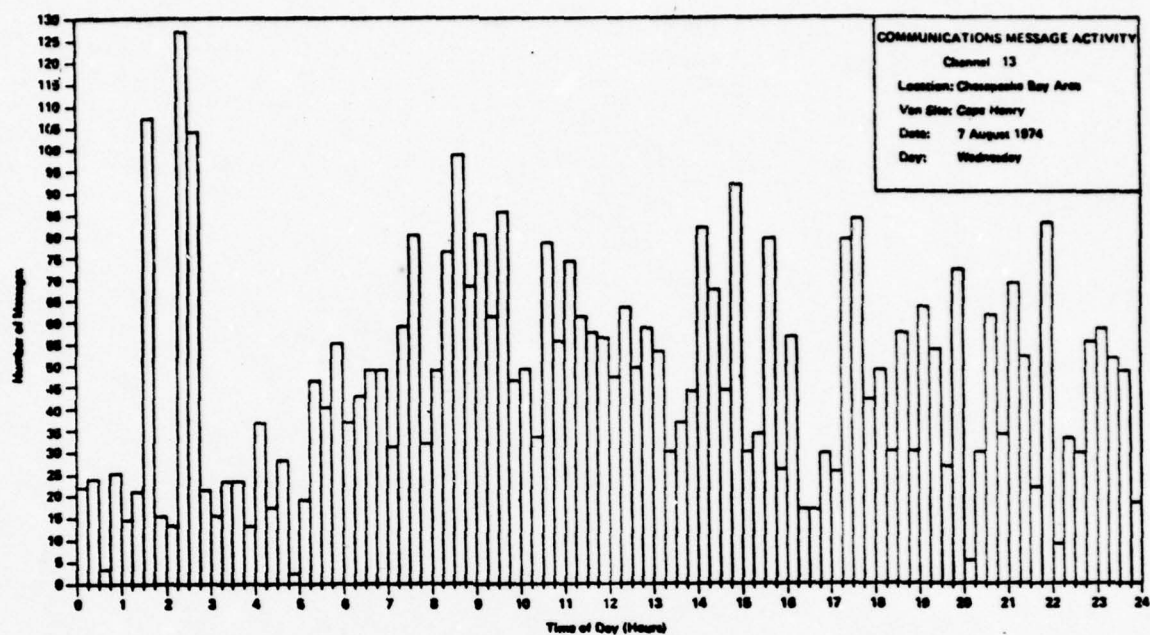
No.	Day	Time Hour/Minute	Distance Yards	Size	Manner of Approach*	Vessel No.	Vessel Size	Average Speed In Knots	Location*	Direction	Day	Time Hour/Minute
1	Thursday 7 August 1974	02 27	100	2 small	C	1	medium	15	TSC	SE	7 August 1974 Wednesday	21 42
2		02 27	200	1 large, 1 small	C	2	medium	14	CBE	SE		21 43
3		02 27	100	1 large, 1 small	P	3	medium	12	TSC	NW		21 44
4		03 03	<50	1 large, 1 small	C	4	large	16	TSC	SE		22 09
5		04 20	200	2 medium	P	5	small	9	TSC	NW		22 11
		05 20	No Data Available			6	large	15	NCBE	East		22 17
6		05 53	<50	1 large, 1 small	C	7	tug with tow	7	CBE	NW		23 11
7		06 21	<75	1 large, 1 small	C	8	tug with tow	8	CC	NW		23 11
8		06 44	<50	1 large, 1 small	C	9	tug with tow	4	CC	SE	8 August 1974 Thursday	23 11
9		07 33	<50	1 large, 1 small	C	10	medium	12	TSC	SE		23 11
10		07 38	<75	1 large, 1 small	C	11	medium	11	NCBE	East		23 11
11		08 55	<95	1 large, 1 small	C	12	large	12	CC	SE		23 11
12		09 20	200	1 large, 1 small	C	13	tug	4	CBE	SE		23 11
13		09 24	290	2 large	P	14	large	19	CC	NW		23 11
14		09 25	120	1 large, 1 small	P	15	large	14	CC	SE		23 11
15		09 34	<95	1 large, 1 small	C	16	medium	7	CBE	NW		23 11
16		09 35	290	1 small, 1 medium	O	17	large	17	TSC	NW		23 11
		09 54	No Data Available			18	medium	8	CC	NW		23 11
		10 52	No Data Available			19	large	11	CC	SE		23 11
17		12 50	230	1 tug, 1 large	C	20	large	10	CBE	SE		23 11
18		14 41	<50	1 large, 1 small	C	21	large	7	CBE	NW		23 11
19		14 58	240	1 tug, 1 medium	P	22	large	15	CC	SE		23 11
		16 18	No Data Available			23	large	12	TSC	NW		23 11
		16 26	No Data Available			24	large	8	CC-TSC	South		23 11
20		17 31	<95	1 large, 1 small	C	25	large	11	CBE	NW		23 11
21		17 53	200	1 large, 1 small	P	26	large	13	TSC	NW		23 11
22		18 02	<95	1 large, 1 small	C	27	large	13	CC	SE		23 11

*P = Passing
O = Overtaking
C = Crossing

*TSC = Thimble Shoal Channel
CC = Chesapeake Channel
CBE = Chesapeake Bay Entrance
NCBE = North Chesapeake Bay Entrance
CC-TSC = Chesapeake Channel to Thimble Shoal Channel

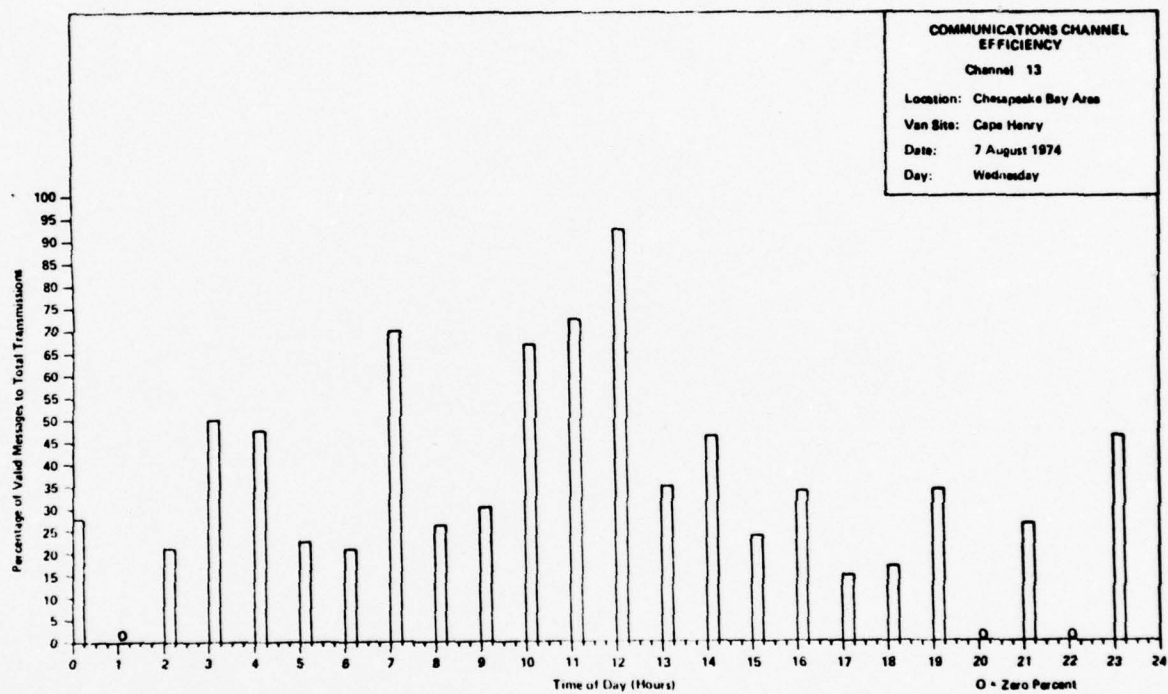
FIGURE E-2 SAMPLE DATA (CONT)





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FIGURE E-2 SAMPLE DATA (CONT)



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FIGURE E-2 SAMPLE DATA (CONT)

I. DISCUSSION OF DATA

1.1 CAPE HENRY SITE

The entrance to the Chesapeake Bay is demarcated by two points of land. On the north is Cape Charles at the tip of the peninsula which forms the eastern shore of the Bay. On the south is Cape Henry at a corner of land from which the south shore of the Bay runs to the west and the Atlantic coast runs to the south. Vessel traffic entering or leaving Chesapeake Bay passes between these two points. Since the water depths off Cape Charles are too shallow for deep draft ships, the normal traffic lanes pass through the deeper waters north of Cape Henry. The radar van was situated on a rise a few feet from the beach at Cape Henry, and the radar equipment was adjusted to a return radius of 6 nm so as to cover this main entrance area.

The great majority of vessels transiting the area enter or exit by way of the marked entrance lanes, the North Chesapeake Bay Entrance and the Chesapeake Bay Entrance. These lanes enter from the northeast and southeast respectively, and come together slightly east of the trapezoidal pilotage area. It is in this area just north of Cape Henry that vessels pick up pilots. They then continue on into the Bay by way of one of two channels, the Thimble Shoal Channel or the Chesapeake Channel. Each of these channels passes over a tunnel area of the Chesapeake Bay Bridge and Tunnel. The Thimble Shoal Channel passes between Chesapeake Bridge Islands number 1 and 2, and continues on toward Hampton Roads. The Chesapeake Channel takes a more northerly route, passing between Islands number 3 and 4 and continuing on through the Bay.

Traffic at this site may be generally described as moving at a constant flow and as engaged in simply passing through the area. The various types of radar data taken reflect certain aspects of this consistency. During one week of observation (6 - 13 August 1974), the vessel density data gives an average of three moving vessels present, with the number of simultaneous movements dropping to zero for less than 9% of the period and rising above six

for less than 3%. There is no marked trend in the vessel density variations, except for a tendency to higher densities midday on Tuesday through Friday. The speed histogram depicts a fairly standard speed distribution between 4 and 19 knots, peaking at 11 and 12 knots. The route identification shows the only local traffic in the area to be pilot boats, while all other vessels are passing through, with most vessels (all large and medium ships) staying within channels and traffic lanes. The pilot boats wait at anchor in the pilotage area for incoming ships. There are at least one and sometimes two pilot boats stationed there at all times. These pilot boats account for the bulk of anchored vessels in the vessel density data. Close encounter data, the last of the radar data, lists only 37 occasions of vessels coming within 300 yards of each other in 23 hours, with all encounters of less than 200 yards involving at least one small vessel.

Communications data were taken for Wednesday, 7 August 1974 - a day of average vessel traffic. The data displays a positive relationship between channel utilization and message activity. Comparing these values over time shows a direct proportion over 71% of the intervals, with 48% of these intervals simultaneously increasing and 52% simultaneously decreasing. Channel utilization and message activity also show a positive relationship to channel efficiency, with this relationship holding for 74% and 65% of the intervals, respectively.

The average channel utilization of 11.45% is low, which is to be expected at a site with vessel density peaking at 12, along with little local activity. The communications data, as well as the radar data, disclose no exceptional observations or anomalies.

1.2 CHESAPEAKE BAY BRIDGE AND TUNNEL ISLAND NUMBER THREE SITE

The Chesapeake Bay Bridge and Tunnel crosses Chesapeake Bay from the mainland at a point in Virginia Beach approximately 10 nm west of the Cape Henry radar van site to Fisherman's Island off Cape Charles. It incorporates three separate bridge trestles, two tunnels, and four man-made islands. In crossing from Virginia Beach to Cape Charles, one first passes over Trestle A to Island #1 and then through the tunnel under Thimble Shoal Channel to Island #2, and on to Trestle B. As this section of the Bridge and Tunnel angles northeast from the shore, it comes within the range of the radar van site at Cape Henry and is shown on the Cape Henry route identification. At the end of Trestle B is Island #3 and the entrance to the tunnel under the Chesapeake Channel. The second radar van location was at the west side of this island, with the radar equipment adjusted to a return radius of 6 nm.

In the center of Island #3 is a brick building covering the entrance to the tunnel. This building was to the east of the radar van location and caused a radar shadow of about 75° to the east of the radar. However, this is in the direction of Cape Henry and so blocks only that area of this site which had been within the range of the Cape Henry radar. There is a clear view of the west side of the Bridge and Tunnel, so this site includes the Thimble Shoal Channel and Chesapeake Channel as they continue northwest to Hampton Roads and York Spit Channel, respectively.

It is to be expected that there be many similarities between the data for Cape Henry and this site as they are adjacent to each other and the same two channels form the major traffic lanes of each. At both sites most vessels (all large and medium ships) stay within channels and, in general, little local activity occurs. At Island #3, however, there are periods during which great numbers of small vessels appear, both moving and at anchor (or drifting). This is due to the fact that the man-made islands near deep waters provide feeding grounds for large fish. When the fish are biting, the information spreads quickly and vessel density counts rise rapidly. The vessel density charts show several examples of this phenomenon. Vessel density counts were taken each 15 minutes for the week of 22-29 August 1974. During this period total vessels present were as high as 46, while the combined numbers of large, medium, and tugs never exceed six. The large numbers of small and anchored vessels which comprise the remainder of the vessels in the counts can be attributed, in the main, to fishing activities.

Other types of radar data are influenced by the presence of fishing boats. The route identification shows 21 out of 37 vessels present as small, and of these 21, 16 appear to be fishing. Of the 48 close encounters occurring within 30 minutes, 47 are between two smalls - a natural result of numerous small vessels clustering close together. Speed values for this site, however, were taken only for vessels traveling within channels, so the speed data reflect the normal traffic patterns of the area, unaffected by the extra-channel activities. The speed distribution for this site is quite similar in form to that of Cape Henry, but is shifted slightly to the right, with values falling between 5 knots and 22 knots, peaking at 15 knots.

Communications data were taken for 23 August 1974 - a day of below average vessel density. The data displays a positive relationship between channel utilization and message activity. Comparing these values over time shows a direct proportion over 72% of the intervals, with 51% of these intervals simultaneously increasing and 49% simultaneously decreasing. Channel utilization and message activity show a tendency toward a positive relationship with channel efficiency, with such a relationship holding for 61% of the intervals for both comparisons.

The average channel utilization of 10.11% is lower than might be expected for a site with vessel densities of up to 46 vessels. However, the great majority of these peak counts are fishing vessels. Apparently, these fishing vessels do not require significant use of channel 13, since when considering non-fishing traffic only, this low utilization seems reasonable; and it is close to the 11.46% utilization obtained at adjacent Cape Henry.

1.3 SEWELLS POINT SITE

Travelling west from the Chesapeake Bay Bridge and Tunnel site, along the shore line of Norfolk, Virginia, to the second northernmost tip of Norfolk, is Sewells Point. Sewells Point is also the northernmost point of the largest U.S. Naval Base in the world. Positioned at Sewells Point, Chesapeake Bay is east; Hampton, Virginia, north; Newport News, Virginia is northwest; Hampton Roads, is north and west; and Portsmouth is south.

The radar van was positioned with the jetty at Sewells Point being west and within 100 feet of the van. The radar equipment on the van was set to a return radius of 3 nm. Approximately 2250 was observed, rotating from southwest to east of the van. This coverage included part of Newport News Channel; Hampton Roads; most of the Hampton River - before entering Hampton, Virginia; some of the Chesapeake Bay area; and the southern-most tip of Willoughby Spit. The south to southwest coverage from the van was not observed possibly due to vessels at their piers. Willoughby Bank from the tunnel house to Willoughby Spit, up to the 3 nm return radius, was not observed because of the obstruction of the bridge. Finally, Willoughby Bay was obscured from vision due to a building east of the van on Sewells Point.

This area of coverage involves such interesting and diverse activities that it would be informative to acquire a general overall picture of what occurs within the 3 nm area of Sewells Point. Entering from the Chesapeake Bay a vessel could go north along the Hampton River. Vessels taking the Hampton River could be carrying oil, heading toward oil refineries in Hampton; vessels in need of repairs; or vessels involved in seafood processing. The route identification showed only one small vessel heading north into Hampton along the Hampton River. The route identification was taken for 18 August, 1974, during 1615-2140 hours, a Sunday, with 22 vessels observed. The next area of interest would be to go south heading to Willoughby Bay. Since the depth of water in this area is 13 feet at most, this would generally account for the presence of small ships. Fishing is done in this area mostly from Fridays to Mondays. The data shows four small vessels present.

Starting again from the Chesapeake Bay area, a vessel could travel southwest along the Entrance Reach which is located adjacent to three large anchorages - ranging from 1000 to 1200 yards in diameter; and then take either the Newport News Channel, or Norfolk Harbor Reach. The division in the Entrance Reach occurs at the beginning of a restricted anchorage area - containing three berths, one of which is 1200 yards in diameter. Two others are 600 yards in diameter. Each of these is an explosive handling berth. When the first berth of 1200 yards in diameter is occupied by vessels carrying explosives, anchoring on either side of the restricted anchorage area on the north side of Newport News channel is forbidden, within 300 yards of the 1200 yard diameter berth. When the two other berths (600 yards

in diameter) are occupied by vessels carrying explosives, anchoring on either side of the restricted anchorage area on the north side of Newport News Channel is forbidden within 425 yards of the two 600 yards diameter berths. The data shows one medium ship, one small ship, and one tug with tow passing by this restricted anchorage area; with three tugs with tow and one small vessel continuing along the Newport News Channel lined with anchorage areas on both sides.

Vessels continuing on the Newport News Channel would most likely take either the James River - northwest, or the Nansemond River - south. The vessels observed on the route identification seem to be heading up the James River. From the area where the Newport News Channel ends and the James River begins, is the Newport News, Virginia area. The shore line for approximately 2 nm is lined with piers - housing nuclear submarines for refueling; piers for unloading coal, tobacco and other commodities; and ship building and dry docking facilities. The 3 nm return radius does not cover this area.

Quite a number of vessels were observed heading from or towards the Norfolk Harbor Reach. The Norfolk Harbor Reach is positioned along the west side of Norfolk. This side of Norfolk has quite a few piers - holding missile destroyers, ammunition cargo supply vessels, and piers housing vessels under repair, vessels under construction, plus other activities.

The next point of interest for vessels to go within this area is the Hampton Flats - northwest of Sewells Point. It is known for its fishing of oysters and clams. The water depth is around 13 feet which allows mostly small vessels. There were no vessels observed in this area on the route identification, yet they were seen in other days of the radar coverage, faintly - most likely because the vessels were small and their turning around motions caused them to appear and disappear frequently. The rest of the possible traffic activity within the area of coverage, as observed on the route identification, occurred between the Hampton Roads and Hampton Flats area - northwest of Sewells Point. This area included one tug with tow, and two small vessels.

The bulk of traffic at this coverage area consists of vessels passing through, and vessels at anchor. The counts of anchored vessels range from 7 to 17, with the average being 12 at one time of count. The route identification shows 12 small ships, 2 medium ships, 2 large ships, and 6 tugs with tow.

The vessel density data covered from 0945 on 14 August 1974 to 0800 on 21 August 1974 - Wednesday to Wednesday respectively. There is no traffic trend throughout the week. The numbers of vessels decrease on the average from the first to last day, with a sharp increase during Saturday and Sunday.

Close encounter data was taken from 1618, 18 August 1974, to 1839 of the same day. During this time there were 50 encounters of less than 200 yards out of a possible 161 encounters. Thus there were 20 close encounters (of less than 200 yards) per hour - or 5 close encounters each 15

minutes. During this same time period the speed data collected showed vessels ranging from 4 - 19 knots. The speed data showed small ships averaging 12 knots, large ships averaging 10 knots, and tugs with tows averaging 5 knots.

Communications data were taken for Friday, 16 August 1974, a day of average vessel traffic. The data displays a positive relationship between channel utilization and message activity. Comparing these values over time shows a direct proportion over 74% of the intervals, with 53% of these intervals simultaneously increasing and 47% simultaneously decreasing. Channel utilization shows a negative relationship to channel efficiency 52% of the time. While message activity shows a positive relationship to channel efficiency 61% of the time.

The lowest, average and highest utilization was .32, 18.58 and 53.09 respectively. This converts to 3 seconds of 15 minutes, 2.79 minutes of 15 minutes and 7.96 minutes of 15 minutes, respectively. The peak vessel density for 16 August 1974 was below average for the entire week of data, with 52 counts being the maximum of the week, and 27 counts being maximum on this day.

1.4 PORTSMOUTH SITE

South of Sewells Point by $3\frac{1}{4}$ nm, the Elizabeth River enters Hampton Roads. Three nm south along the river, the Eastern Branch and Southern Branch meet to form the river. It is this intersection area that is the site observed at Portsmouth. The radar van was located approximately $\frac{2}{3}$ nm south of the intersection on the Southern Branch at the Coast Guard Station. The radar equipment was adjusted to a return radius of 1.5 nm, however, all radar returns were blocked out except for those from the intersection area and three short approaches to the area from the Southern Branch, Eastern Branch, and Elizabeth River, of approximately $\frac{1}{2}$ nm, $\frac{1}{4}$ nm, and $\frac{1}{2}$ nm, respectively.

Two aspects of this site mark major distinctions between Portsmouth and the other five Chesapeake area sites. The first is that this is an area of highly confined waterways. The approaches from the Southern Branch and Eastern Branch are 500 ft. wide and the approach from the Elizabeth River is 800 ft. wide. The second distinguishing aspect is the presence of considerable local traffic. Local activities include travel among the many docks and wharves lining the shores, travel to and from the marina at the intersection and tourist boats leaving and returning to the tour boat dock just north of the intersection. As the area is small, vessel density counts are low. With counts peaking at six, it is expected that the presence of these varied local activities accounts for a high percentage of area traffic. The route identification shows this to be the case, with 15 of the 30 vessels traced during four hours engaged in local traffic.

Speed and close encounter data for Portsmouth reflect the influence of confined waterways. The speeds at Portsmouth have the lowest range (3 to 12 knots) and lowest average (7.2 knots) of the six Chesapeake area sites. The ratio of close encounters to encounters is highest for Portsmouth. 79% of all encounters are close encounters, while the same ratio for each of the five other sites falls between 20% and 56%.

Communications data were taken for Thursday, 5 September 1974 - a day of average vessel traffic. The data displays a positive relationship between channel utilization and message activity. Comparing those values over time shows a direct proportion over 74% of the intervals, with 54% of these intervals simultaneously increasing and 52% simultaneously decreasing. Message activity also shows a positive relationship to channel efficiency, with a direct proportion holding over 73% of the intervals. The relationship between channel utilization and channel efficiency is less clear, with a positive relationship over intervals of 59%.

1.5 POINT LOOKOUT SITE

Near the center of the Chesapeake Bay, at the tip of the peninsula where the Potomac River empties into the Chesapeake Bay is Point Lookout, Maryland.

The radar van was placed at a location less than 200 yards inland on Point Lookout. A radius of 12 nm was visible by the radar equipment. This radius encompassed approximately 6 nm of the Potomac River, extending to St. Marys River, and nearly 24 nm of the Chesapeake Bay.

Small boats account for the bulk of traffic at this site. As indicated by the route identification chart, Point Lookout is a favorite launching site for boats that fish in the Chesapeake Bay, which is abundant with fish trap areas.

There are no defined channels at this site, so we see all sizes of ships covering the width of the Bay travelling northwesterly and southeasterly. The only limitations in their pattern are the Naval target areas within the restricted area which is east of Point Lookout extending north in the Bay. The other zone avoided by vessels is the danger area on the eastern side of the Chesapeake Bay, which is host to unexploded bombs.

There was very little traffic in the Potomac River. The route identification chart shows only one small boat there in the time period covered.

Vessel density and close encounter data at this site show that on September 13, 1974 there are up to 6 close encounters occurring during seven minutes before and after the highest vessel density periods of that day. Message activity and channel utilization data indicate that 77% of the intervals on September 11, 1974 have a directly proportional relationship between the number of messages and the channel utilization of these intervals. A little more than half of the percentages obtain a decrease in utilization along with a decrease in message activity. The remaining percentage shows a reverse trend.

Point Lookout had a small amount of vessel activity. The maximum number of vessels seen here at any one time interval was 10. Sandy Point, for example, had a maximum of 34 ships.

1.6 SANDY POINT SITE

Sandy Point, a small resort area, is the northernmost of the six Chesapeake Bay area sites. It lies on the western shore of Maryland, approximately five miles northeast of Annapolis. Ships going to Baltimore from any point south of the Chesapeake Bay Bridge have to pass Sandy Point.

The radar van was situated a quarter mile inland on Sandy Point enabling the radar equipment to span vessel activity within a radius of six nm. Within this locus the shallow water on the Sandy Point side of the Chesapeake Bay and the land mass immediately west of it were not visible. The Chesapeake Bay Bridge obscured vision of that part of the Bay lying south of it. Vessel movement in the cable area between Craighill Entrance Channel and Bay Bridge was sometimes curtailed.

As observed from the route identification chart the three most traversed routes at Sandy Point are: (1) Craighill Channel to/from Chesapeake Bay Bridge, (2) the bend connecting Tolchester Channel with Brewerton Channel Eastern Extension to/from Chesapeake Bay Bridge, and (3) Swan Point Channel to/from Chesapeake Bay Bridge. Of these three routes, Craighill Channel is the most travelled. It is the major channel at this site, with an average depth of 42 feet and width of 800 feet. Craighill serves as the southern entrance to Baltimore Harbor, which accounts for its having a larger volume of traffic than the other routes at this site.

Small boats (mostly fishing boats) use all three routes. Fishing boats are observed moving to and from Bay Bridge and the Swan Point Channel area. They also frequent fish trap areas around Kent Island where they were observed circling or stopping intermittently. Tug traffic is scarce at this site, however two are observed traversing Craighill Channel. Large ships are seen moving in the Craighill Channel and the central Chesapeake Bay.

The relationship between radar vessel density and message activity on channel 13 was examined. For a high vessel density period between 1030 and 1330 on September 17, 1974, when a 65% above average vessel activity was determined, message activity on Channel 13 was 38% below average. Message activity peaked toward the end of that day when vessel density was at its lowest, showing a negative correlation between the two activities.

Message activity and channel 13 utilization on September 17, 1974 are directly proportional for 74% of the total intervals that day. Half of this percentage shows an increase in utilization along with an increase in message activity. The remaining percentage shows the reverse trend.

1.7 DETAILED DATA SUMMARY

The following observations can be made on the data collected for each site in the Chesapeake Bay Area:

1. Vessel Density

- A peak traffic period is defined as a time interval during which vessel density is within 50% of the peak value for the site, and is sustained for more than 15 minutes. A lack of peak periods indicates relatively uniform traffic activity throughout the day.

Based on this definition of a peak period, these observations were made:

- Cape Henry - had a mode of four peak periods per day, but there was no consistency in the times of their occurrence.
- Chesapeake Bay Bridge and Tunnel - obtained peak periods from 0945-1400; and 1415-1730.
- Sewells Point - the longest sustained peak period here was from 1515-2000; generally however, they tended to occur around 1200.
- Portsmouth - had peak periods occurring within the range of 1245-1700.
- Point Lookout - the tendency here was for peak periods to focus around 0015; 1215; and 2300 hours.
- Sandy Point - sustained one peak period from 0630-2000. Four other peak periods of much shorter duration were observed around 1345; 1745; and from 0630-1215.

2. Route Identification

The following definitions will apply to all route identification charts: A tug with tow is a small vessel pulling one or more other vessels. Small, medium, and large ships are so defined in a comparative relationship. A small ship is further delineated as it is never larger than the small, pulling vessel referred to in the tug with tow definition. Very small vessels do not appear on route identification charts as their returns are too intermittent to allow tracing of their paths.

The route identification charts referred to in Section 2 indicate the following:

- Cape Henry (coverage - 0111-1339, 7 August 1974)

<u>Type of Vessel</u>	<u>No. of Vessels Present</u>	<u>Direction</u>
Small Ship	4	Thimble Shoal Channel, East
	4	Thimble Shoal Channel, West
Medium Ship	2	Chesapeake Channel, North
	3	Thimble Shoal Channel, East
Large Ship	6	Thimble Shoal Channel, West
	3	Chesapeake Channel, North
	2	Thimble Shoal Channel, East
Tug with Tow	1	Chesapeake Channel, North
	1	Thimble Shoal Channel, East
	1	East, crossing Chesapeake channel
Pilot Ship	8	Pilotage area, circling
Total No. of Vessels	35	

About a mile north of Cape Henry, the channels, Chesapeake and Thimble Shoal, meet. Within this one mile locus is the Pilotage Area, where the route identification chart depicts the movement of the pilot ships meeting other vessels at the fork of the two channels, to perform their navigational services. The density of vessel activity along the channels shows for Cape Henry, a greater mix of vessel type when compared to those of the five other sites. Still, there is a tendency for small ships to use Thimble Shoal more than Chesapeake Channel.

● Chesapeake Bay Bridge and Tunnel (coverage 0819-1329, 24 August 1974)

<u>Type of Vessel</u>	<u>No. of Vessels Present</u>	<u>Direction</u>
Small Ship	1	Chesapeake Bay, North
	10	Chesapeake Bay, South
	8	Chesapeake Bay Bridge, North
	1	Thimble Shoal Channel, East
	1	Thimble Shoal Channel, West
Medium Ship	1	Chesapeake Bay, South
	1	Chesapeake Bay, North
	2	Thimble Shoal Channel, East
Large Ship	1	Thimble Shoal Channel, West
	1	Chesapeake Bay, North
	1	Chesapeake Bay, South
	1	Thimble Shoal Channel, East
Tug with Tow	1	Thimble Shoal Channel, West
	3	Chesapeake Bay, North
	2	Chesapeake Bay, South
	1	Thimble Shoal Channel, East
Total No. of Vessels	37	

The two major channels at this site, Thimble Shoal and Chesapeake Channel, have a balance in their comparative traffic densities as they attract an equal proportion of vessels. And each of the four vessel types are seen using these channels, again in a seemingly equal proportion. However, a nest of small ships dart in and around the center of the picture, on either side of the Bridge. Tugs with tow sometimes travel northeasterly across Thimble Shoal towards Chesapeake Channel.

- Sewells Point (coverage 1615-2140, 18 August 1974)

<u>Type of Vessel</u>	<u>No. of Vessels Present</u>	<u>Direction</u>
Small Ship	2	Entrance Reach, South
	2	Newport News Channel, West
	2	Sewells Point Spit, East
	6	Entrance Reach, North
Medium Ship	1	Entrance Reach, North
	1	Entrance Reach, South
Large Ship	1	Entrance Reach, North
	1	Entrance Reach, South
Tug with Tow	2	Entrance Reach, South
	1	Entrance Reach, North
	2	Newport News Channel, East
	1	Newport News Channel, West
Total No. of Vessels		22

The most dense traffic flow is in the southerly trip from the Entrance Reach to Norfolk Harbor Reach. Tugs with tow sometimes describe a loop around Sewells Point, when they travel between Norfolk Harbor Reach and the Newport News Channel; others run northeasterly and southwesterly, to and from Newport News Channel and the Entrance Reach. The small ships, dominating traffic at this site, carve a curious route, one that typifies the movement of recreation vessels.

- Portsmouth (coverage 1612-2000, 2 September 1974)

<u>Type of Vessel</u>	<u>No. of Vessels Present</u>	<u>Direction</u>
Small Ship	4	Town Point Reach, North
	5	Town Point Reach, South
Medium Ship	2	Town Point Reach, West
	3	Town Point Reach, North
	6	Town Point Reach, South
Large Ship	2	Town Point Reach, South
Tug with Tow	5	Town Point Reach, North
	3	Town Point Reach, South
Total No. of Vessels		30

Portsmouth had a dichotomy in its traffic flow. Fifteen, or one-half the 30 vessels listed above were "local" traffic, in that their movements were within the perimeter of the Portsmouth site while the remaining half was thru traffic. Traffic condensed along the Elizabeth River and the Southern Branch. East of the intersection area lay the somewhat narrower Eastern Branch that was scarcely travelled. The Elizabeth River - Southern Branch traffic area is also referred to as Town Point Reach.

- Point Lookout (coverage 0715-1210, 13 September 1974)

<u>Type of Vessel</u>	<u>No. of Vessels Present</u>	<u>Direction</u>
Small Ship	5	Chesapeake Bay, North
	12	Potomac River, East
	4	Chesapeake Bay, South
	2	Potomac River, West
Large Ship	3	Chesapeake Bay, South
	2	Chesapeake Bay, North
Tug with Tow	1	Chesapeake Bay, North
Total No. of Vessels 29		

At Point Lookout, the large ships travel the long, open waters of Chesapeake Bay. The small ships, most predominantly seen at this site, tend to leave the land mass of Point Lookout for the fringe where the shallow water around Point Lookout meets the deep of Chesapeake Bay. On the route identification diagram, these small ships weave a path much like the center of a spider's web.

- Sandy Point (coverage 1300-1700, 17 September 1974)

<u>Type of Vessel</u>	<u>No. of Vessels Present</u>	<u>Direction</u>
Small Ship	10	Chesapeake Bay, North
	2	Chesapeake Bay, West
	1	Chesapeake Bay, East
	3	Craighill Channel, South
	5	Chesapeake Bay, South
Large Ship	1	Craighill Channel, South
	1	Chesapeake Bay, South
	1	Chesapeake Bay, North
	3	Craighill Channel, North
Tug with Tow	1	Craighill Channel, North
	1	Craighill Channel, South
Total No. of Vessels 29		

In its route identification chart, Sandy Point springs up three distinct routes. Each route is well travelled by small ships, which incidentally is the sole vessel type utilizing the shallow water west of Kent Island. The tugs with tow observed in the time frame traverse Craighill Channel only, while the large ships use both Craighill Channel and the open water between Craighill and Swan Point Channel.

3. Vessel Speed

Observed speeds in the Chesapeake Bay area had the following ranges:

- Cape Henry 4 - 30 knots (12.4 knot average)
- Chesapeake Bay Bridge and Tunnel 5 - 22 knots (13.3 knot average)
- Sewells Point 4 - 19 knots (10.1 knot average)
- Portsmouth 3 - 12 knots (7.2 knot average)
- Point Lookout 3 - 20 knots (11.4 knot average)
- Sandy Point 3 - 19 knots (9.6 knot average)

The following data represents the fastest, slowest, and average speed (given in knots) for each type of vessel present - according to site.

- Cape Henry (24 hours of coverage between 7 and 8 August 1974)

<u>Type of Vessel</u>	<u>No. of Vessels Present</u>	<u>Fastest</u>	<u>Slowest</u>	<u>Average</u>
Small ship	1	9	9	-
Medium ship	12	19	7	12.6
Large ship	38	30	7	13.2
Tug with tow	<u>4</u>	8	4	5.8
Total	55			

- Chesapeake Bay Bridge and Tunnel (52 hours of coverage between 22 and 24 August 1974)

<u>Type of Vessel</u>	<u>No. of Vessels Present</u>	<u>Fastest</u>	<u>Slowest</u>	<u>Average</u>
Small ship	12	20	5	10.6
Medium ship	19	20	8	14.1
Large ship	28	22	8	14.9
Tug with tow	<u>6</u>	12	5	8.7
Total	65			

- Sewells Point (17½ hours of coverage between 19 and 20 September 1974)

<u>Type of Vessel</u>	<u>No. of Vessels Present</u>	<u>Fastest</u>	<u>Slowest</u>	<u>Average</u>
Small ship	19	19	6	12.1
Large ship	24	17	4	9.8
Tug with tow	<u>7</u>	9	4	5.4
Total	50			

- Portsmouth (7 hours of coverage on 30 August 1974)

<u>Type of Vessel</u>	<u>No. of Vessels Present</u>	<u>Fastest</u>	<u>Slowest</u>	<u>Average</u>
Small ship	14	12	5	8.8
Medium ship	8	8	3	6.5
Large ship	9	8	4	5.8
Tug with tow	<u>1</u>	3	3	-
Total	32			

- Point Lookout (35½ hours of coverage between 13 and 14 September 1974)

<u>Type of Vessel</u>	<u>No. of Vessels Present</u>	<u>Fastest</u>	<u>Slowest</u>	<u>Average</u>
Small ship	12	18	6	9.3
Large ship	34	20	5	12.5
Tug with tow	<u>4</u>	9	3	5.8
Total	50			

- Sandy Point (24½ hours of coverage between 17 and 18 September 1974)

<u>Type of Vessel</u>	<u>No. of Vessels Present</u>	<u>Fastest</u>	<u>Slowest</u>	<u>Average</u>
Small ship	21	19	4	10.2
Large ship	33	15	3	9.7
Tug with tow	<u>13</u>	14	4	8.5
Total	67			

The following data presents the different speeds, for each type of vessel, at each site:

<u>Small Ships at:</u>	<u>No. of Vessels Present</u>	<u>Fastest</u>	<u>Slowest</u>	<u>Average</u>
Cape Henry	1	9	9	-
Chesapeake Bay Bridge and Tunnel	12	20	5	10.6
Sewells Point	19	19	6	12.1
Portsmouth	14	12	5	8.8
Point Lookout	12	18	6	9.3
Sandy Point	21	<u>19</u>	<u>4</u>	<u>10.2</u>
	Average	16.2	5.8	10.2

<u>Medium Ships at:</u>	<u>No. of Vessels Present</u>	<u>Fastest</u>	<u>Slowest</u>	<u>Average</u>
Cape Henry	12	19	7	12.6
Chesapeake Bay Bridge and Tunnel	19	20	8	14.1
Sewells Point	0	-	-	-
Portsmouth	8	8	3	6.5
Point Lookout	0	-	-	-
Sandy Point	0	<u>-</u>	<u>-</u>	<u>-</u>
	Average	15.7	6.0	11.1

<u>Large Ships at:</u>	<u>No. of Vessels Present</u>	<u>Fastest</u>	<u>Slowest</u>	<u>Average</u>
Cape Henry	38	30	7	13.2
Chesapeake Bay Bridge and Tunnel	28	22	8	14.9
Sewells Point	24	17	4	9.8
Portsmouth	9	8	4	5.8
Point Lookout	34	20	5	12.5
Sandy Point	33	<u>15</u>	<u>3</u>	<u>9.7</u>
	Average	18.7	5.2	11.0

<u>Tugs with tow at:</u>	<u>No. of Vessels Present</u>	<u>Fastest</u>	<u>Slowest</u>	<u>Average</u>
Cape Henry	4	8	4	5.8
Chesapeake Bay Bridge and Tunnel	6	12	5	8.7
Sewells Point	7	9	4	5.4
Portsmouth	1	3	3	-
Point Lookout	4	9	3	5.8
Sandy Point	13	<u>14</u>	<u>4</u>	<u>8.5</u>
	Average	9.2	3.8	6.8

4. Close Encounters

The observed rate of close encounters are as follows:

Cape Henry	37 in 23 hours (1.6) out of 76 total encounters
Chesapeake Bay Bridge and Tunnel	48 in ½ hour (96) out of 85 total encounters
Sewells Point	50 in 2½ hours (20) out of 161 total encounters
Portsmouth	33 in 2½ hours (13.2) out of 42 total encounters
Point Lookout	20 in 24 hours (0.8) out of 100 total encounters
Sandy Point	47 in 2 hours (23.5) out of 92 total encounters

The numbers in parenthesis were obtained by dividing the number of hours into the number of close encounters (i.e. number of close encounters per hour). The dominance of the Chesapeake Bay Bridge and Tunnel is evident.

The observed close encounters have the following ranges in yards for each vessel-type combination at each site. The manner of approach is also shown for each number of vessels in each type of combination (P = Passing, O = Overtaking, C = Crossing). Note that the actual range between two vessels could be closer. Radar resolution limits the accuracy of measured distances.

• Cape Henry (23 hour coverage)

<u>No. & Manner of Approach</u>			<u>Type of Vessel Combination</u>	<u>No. of Combinations Observed</u>	<u>Range of Close Encounters (Yards)</u>
<u>P</u>	<u>O</u>	<u>C</u>			
-	-	1	2 small ships	1	100
1	-	-	2 medium ships	1	200

No. & Manner of Approach			Type of Vessel Combination	No. of Combinations Observed	Range of Close Encounters (Yards)
P	O	C			
1	-	-	2 large ships	1	290
1	-	-	2 tugs	1	240
-	1	-	1 small ship and 1 medium ship	1	290
7	-	20	1 small ship and 1 large ship	27	< 50 - 200
-	-	1	1 small ship and 1 tug	1	< 50
1	-	-	1 medium ship and 1 large ship	1	280
1	-	-	1 medium ship and 1 tug	1	240
<u>1</u>	<u>-</u>	<u>1</u>	1 large ship and 1 tug	<u>2</u>	300
13	1	23	Totals	37	

● Chesapeake Bay Bridge and Tunnel ($\frac{1}{2}$ hour coverage)

No. & Manner of Approach			Type of Vessel Combination	No. of Combinations Observed	Range of Close Encounters (Yards)
P	O	C			
28	9	10	2 small ships	47	< 40 - 300
-	<u>1</u>	-	2 large ships	<u>1</u>	210
28	10	10	Totals	48	

● Sewells Point ($2\frac{1}{2}$ hour coverage)

No. & Manner of Approach			Type of Vessel Combination	No. of Combinations Observed	Range of Close Encounters (Yards)
P	O	C			
32	6	7	2 small ships	45	< 25 - 200
-	1	-	1 small ship and 1 medium ship	1	< 25
1	1	1	1 small ship and 1 large ship	3	150 - 200
<u>1</u>	<u>-</u>	<u>-</u>	1 large ship and 1 tug	<u>1</u>	200
34	8	8	Totals	50	

● Portsmouth ($2\frac{1}{2}$ hour coverage)

No. & Manner of Approach			Type of Vessel Combination	No. of Combinations Observed	Range of Close Encounters (Yards)
P	O	C			
14	6	1	2 small ships	21	< 25 - 90
1	-	-	2 medium ships	1	80
8	1	-	1 small ship and 1 medium ship	9	< 25 - 80
<u>2</u>	<u>-</u>	<u>-</u>	1 small ship and 1 large ship	<u>2</u>	40
25	7	1	Totals	33	

● Point Lookout (24 hour coverage)

No. & Manner of Approach			Type of Vessel Combination	No. of Combinations Observed	Range of Close Encounters (Yards)
P	O	C			
9	8	-	2 small ships	17	< 85 - 400
1	-	-	2 large ships	1	400
-	-	1	1 small ship and 1 large ship	1	240
-	1	-	1 small ship and 1 tug	1	< 90
10	9	1	Totals	20	

● Sandy Point (2 hour coverage)

No. & Manner of Approach			Type of Vessel Combination	No. of Combinations Observed	Range of Close Encounters (Yards)
P	O	C			
1	-	-	2 very small ships	1	100
23	10	8	2 small ships	41	< 60 - 280
-	-	-	2 large ships	1	200
1	-	-	1 very small ship and 1 small ship	1	< 80
2	-	1	1 small ship and 1 tug	3	110 - 210
28	10	9	Totals	47	

5. Channel Utilization

Channel 13 utilization exhibited the following peak and average percentages:

	<u>Day of Coverage</u>	<u>Peak (%)</u>	<u>Time of Peak</u>	<u>Average (%)</u>
Cape Henry	Wednesday, 7 August 1974	42	1415 - 1430	11
Chesapeake Bay Bridge and Tunnel	Friday, 23 August 1974	88	2245 - 2300	10
Sewells Point	Friday, 16 August 1974	53	0945 - 1000	19
Portsmouth	Thursday, 5 September 1974	81	2315 - 2330	16
Point Lookout	Wednesday, 11 September 1974	31	0145 - 0200	9
Sandy Point	Tuesday, 17 September 1974	75	2330 - 2345	14

6. Message Activity

Message activity exhibited the following peak and average values for channel 13:

	<u>Day of Coverage</u>	<u>Peak No. of Messages</u>	<u>Time of Peak</u>	<u>Average No. of Messages</u>
Cape Henry	Wednesday, 7 August 1974	127	0215 - 0230	46
Chesapeake Bay Bridge and Tunnel	Friday, 23 August 1974	316	1430 - 1445	65
Sewells Point	Friday, 16 August 1974	250	0915 - 0930	64
Portsmouth	Thursday, 5 September 1974	222	1815 - 1830	84
Point Lookout	Wednesday, 11 September 1974	163	0415 - 0430	36
Sandy Point	Tuesday, 17 September 1974	213	2115 - 2130	56

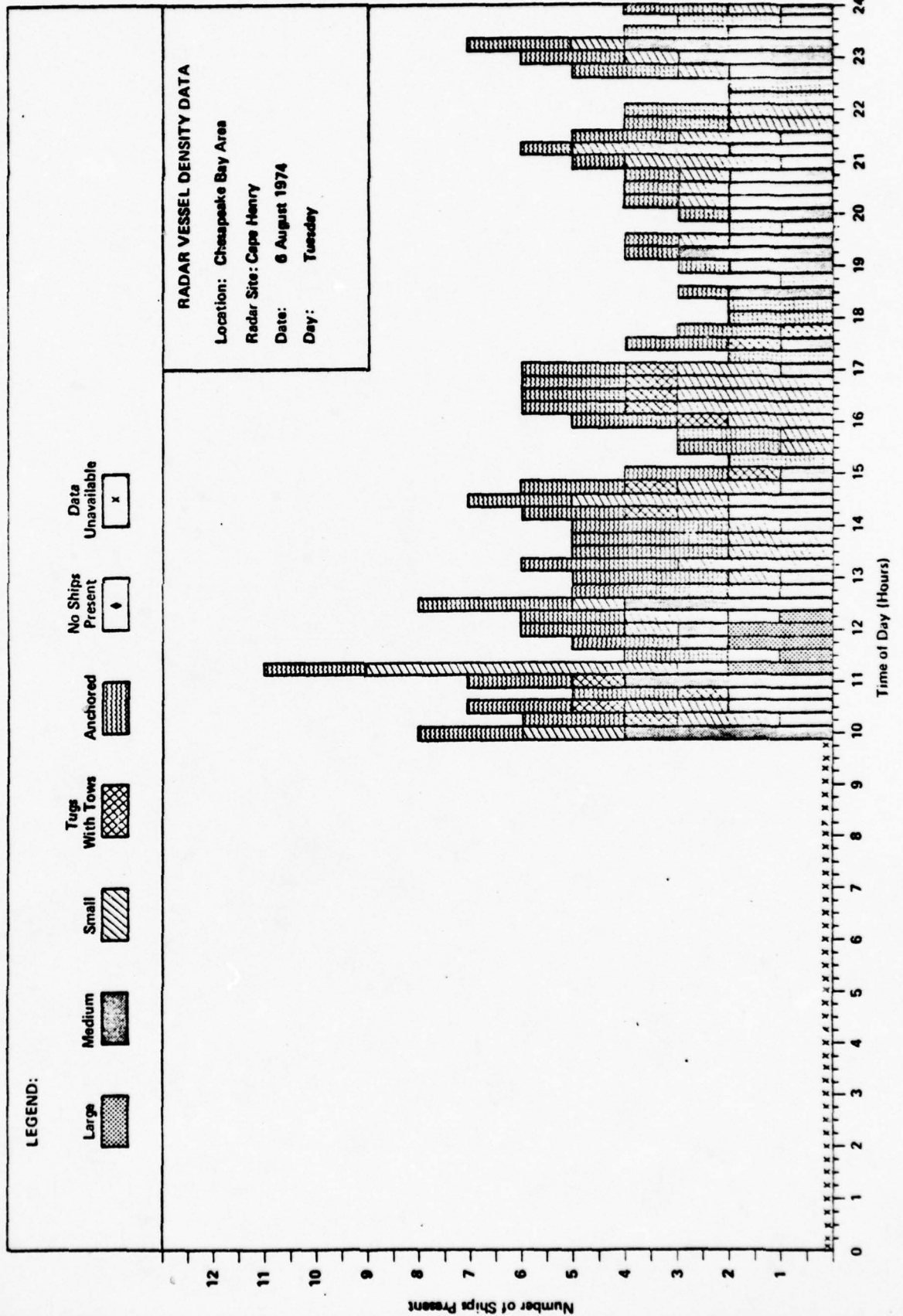
7. Channel Efficiency

Channel efficiency data are as follows:

	<u>Peak (%)</u>	<u>Average (%)</u>
Cape Henry	93	34
Chesapeake Bay Bridge and Tunnel	85	41
Sewells Point	100	51
Portsmouth	74	35
Point Lookout	83	43
Sandy Point	89	50

II. DATA

2.1 DATA FROM CAPE HENRY



LEGEND:

Large

Medium

Small

Tugs
With Tows

Anchored

No Ships
Present

Data
Unavailable

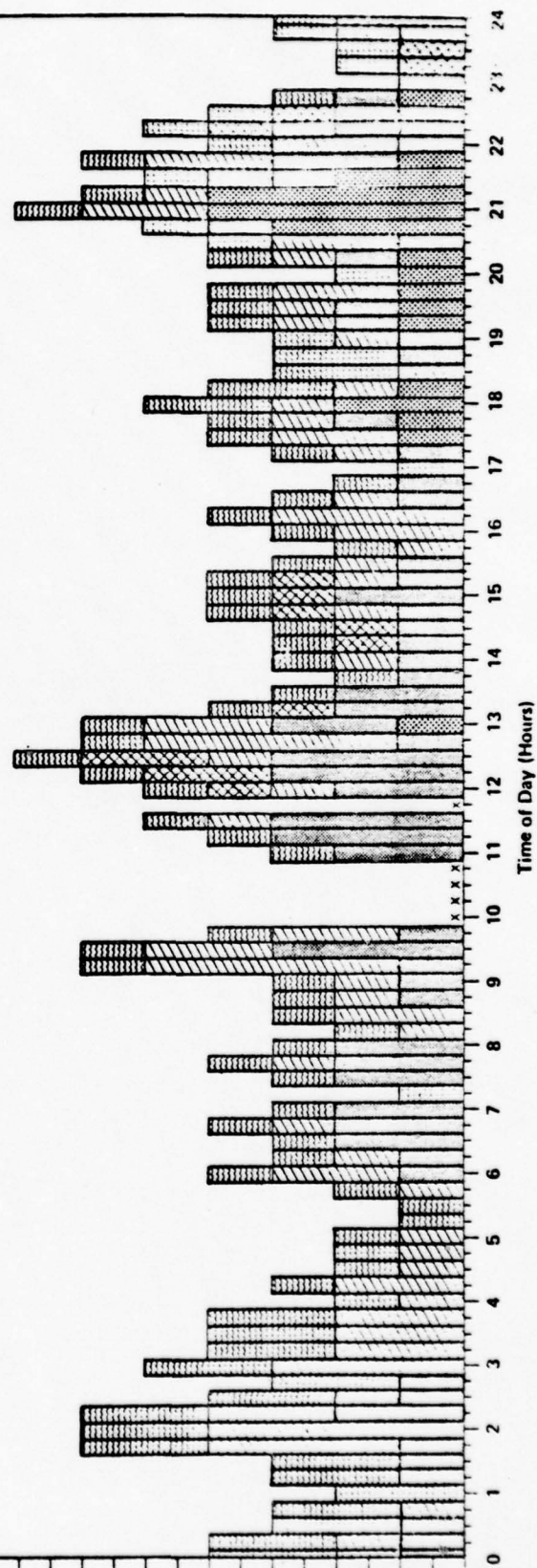
RADAR VESSEL DENSITY DATA

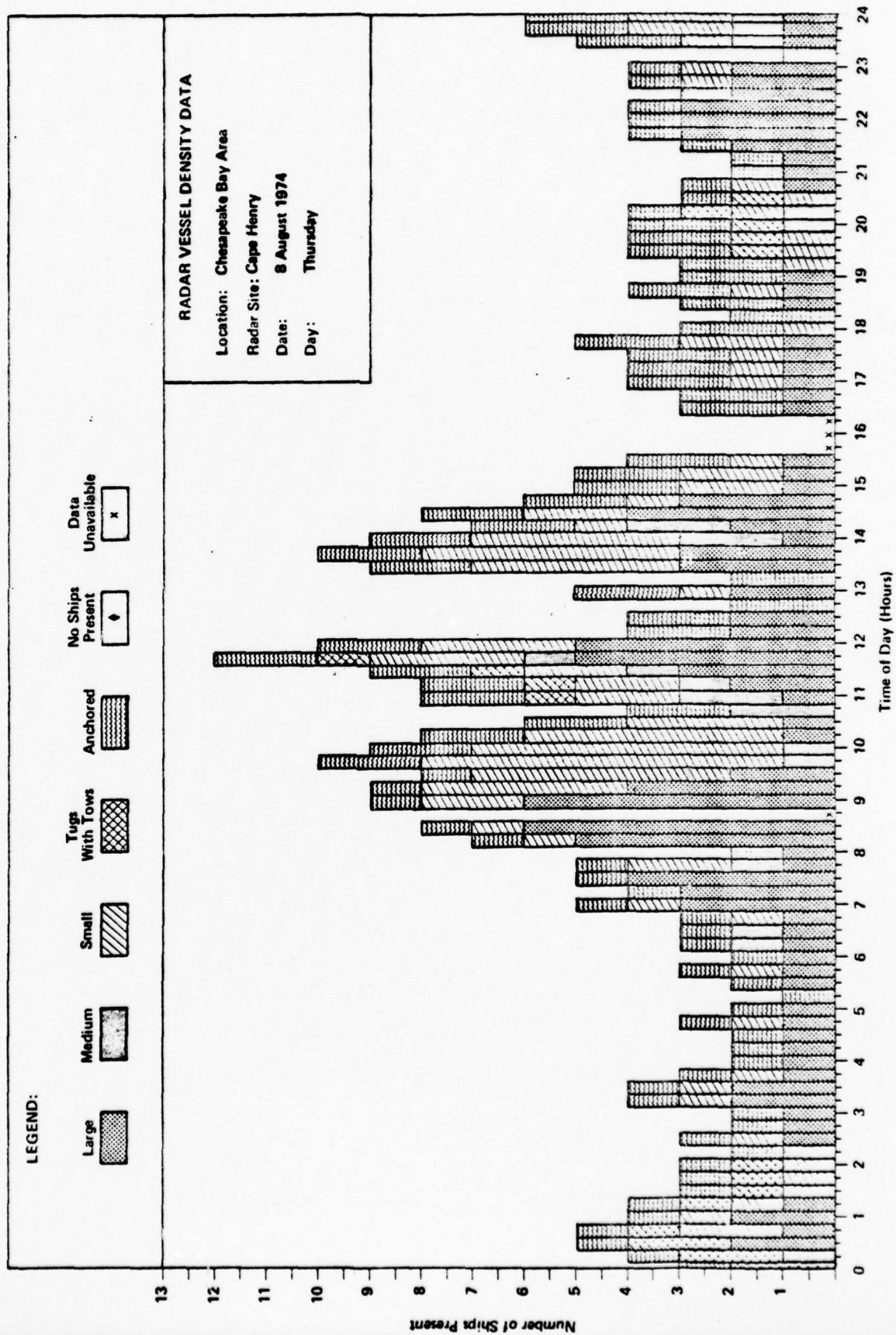
Location: Chesapeake Bay Area

Radar Site: Cape Henry

Date: 7 August 1974

Day: Wednesday

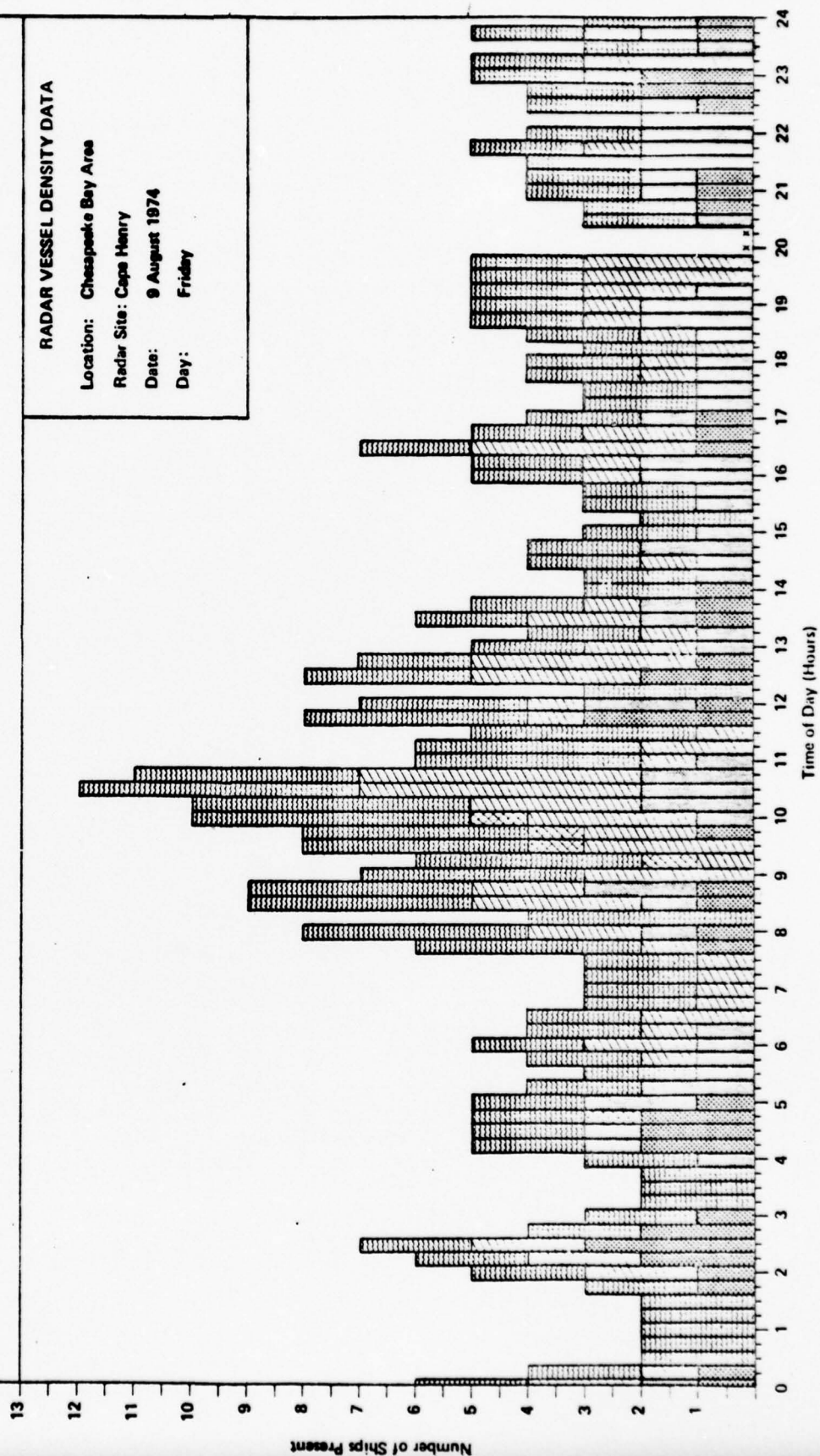


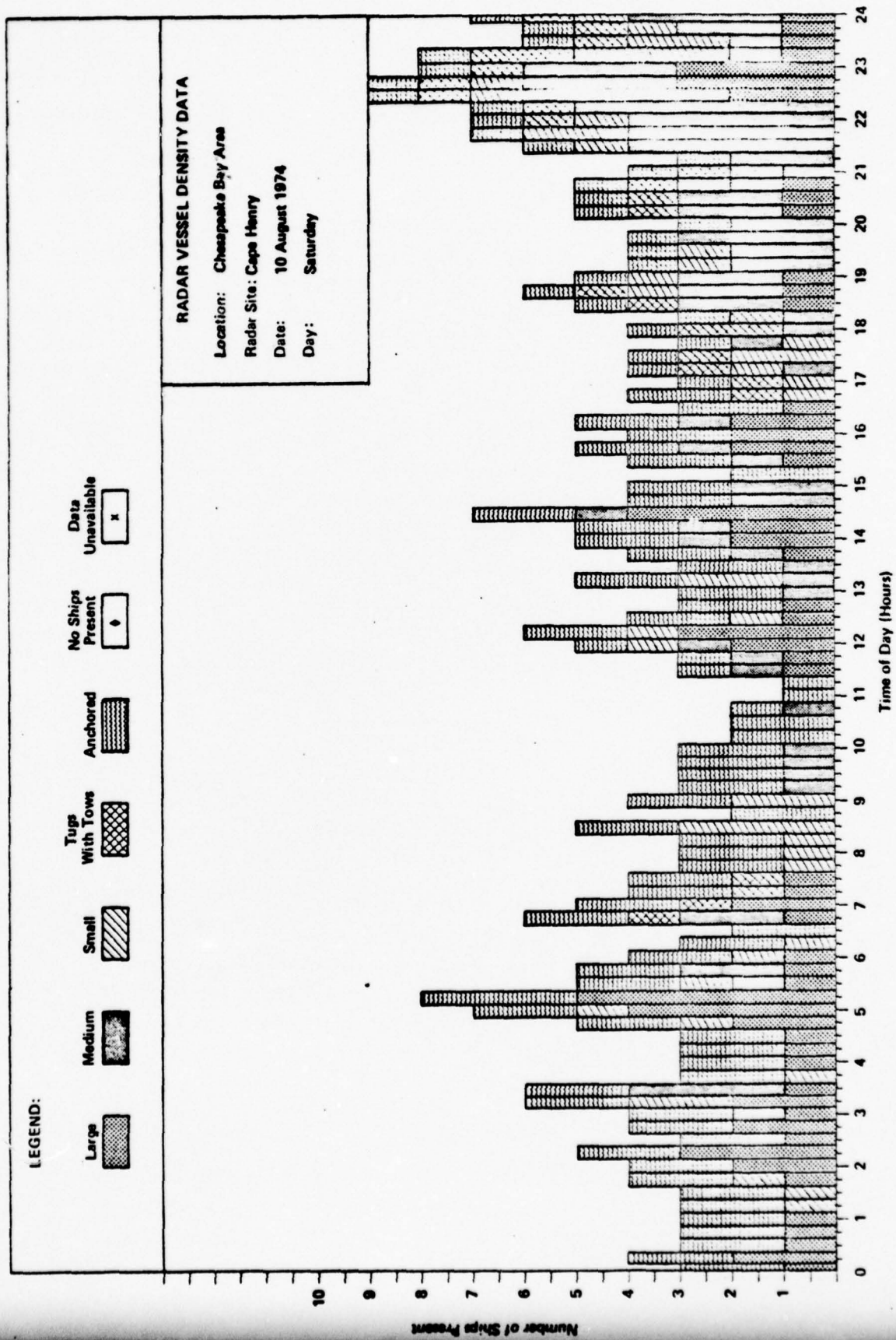


Day: Friday

Day: Friday

Large 





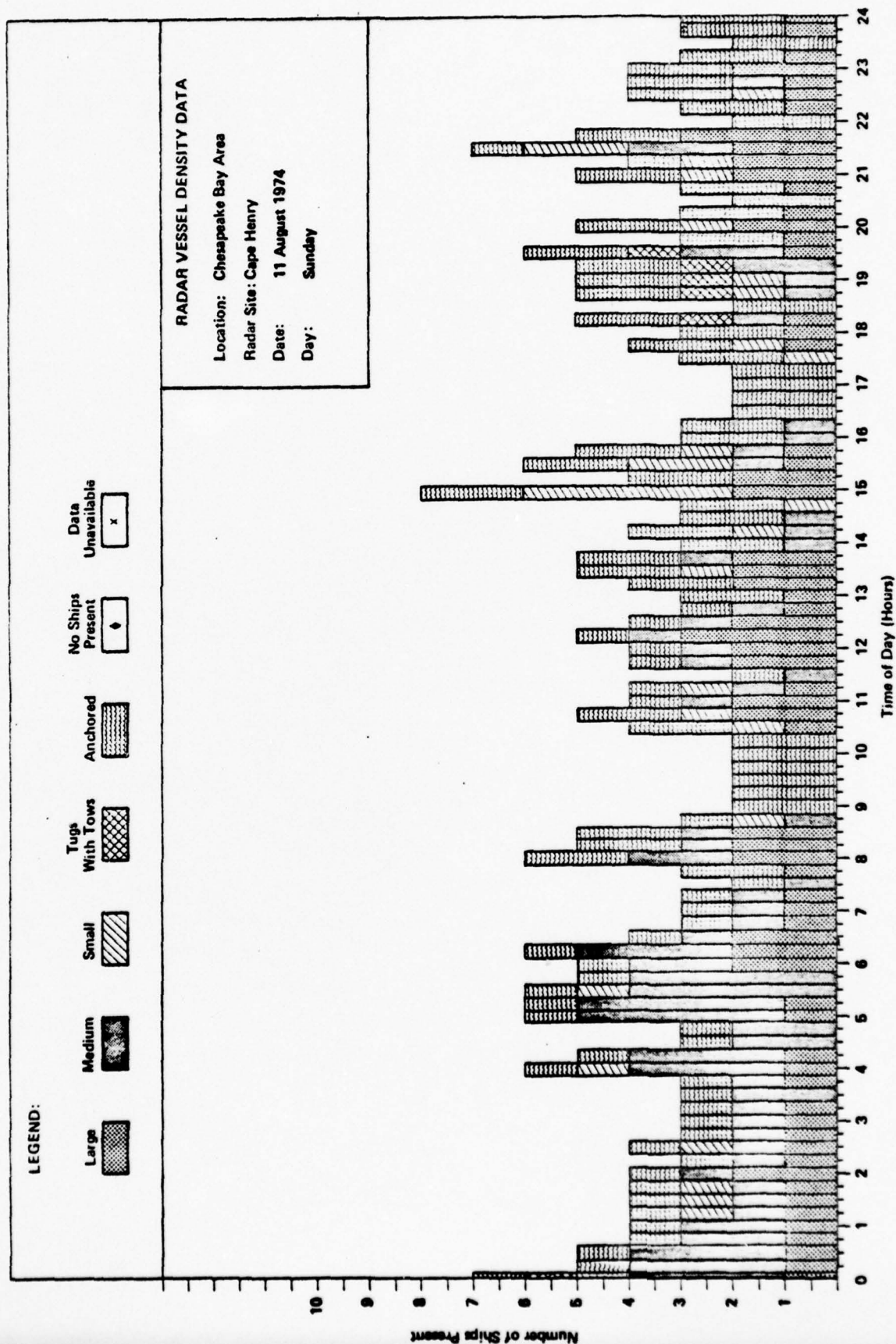
Location: Chesapeake Bay Area
Radar Site: Cape Henry
Date: 11 August 1974
Day: Sunday

Location: Chesapeake Bay Area

Radar Site: Cape Henry

Date: 11 August 1974

Day: Sunday

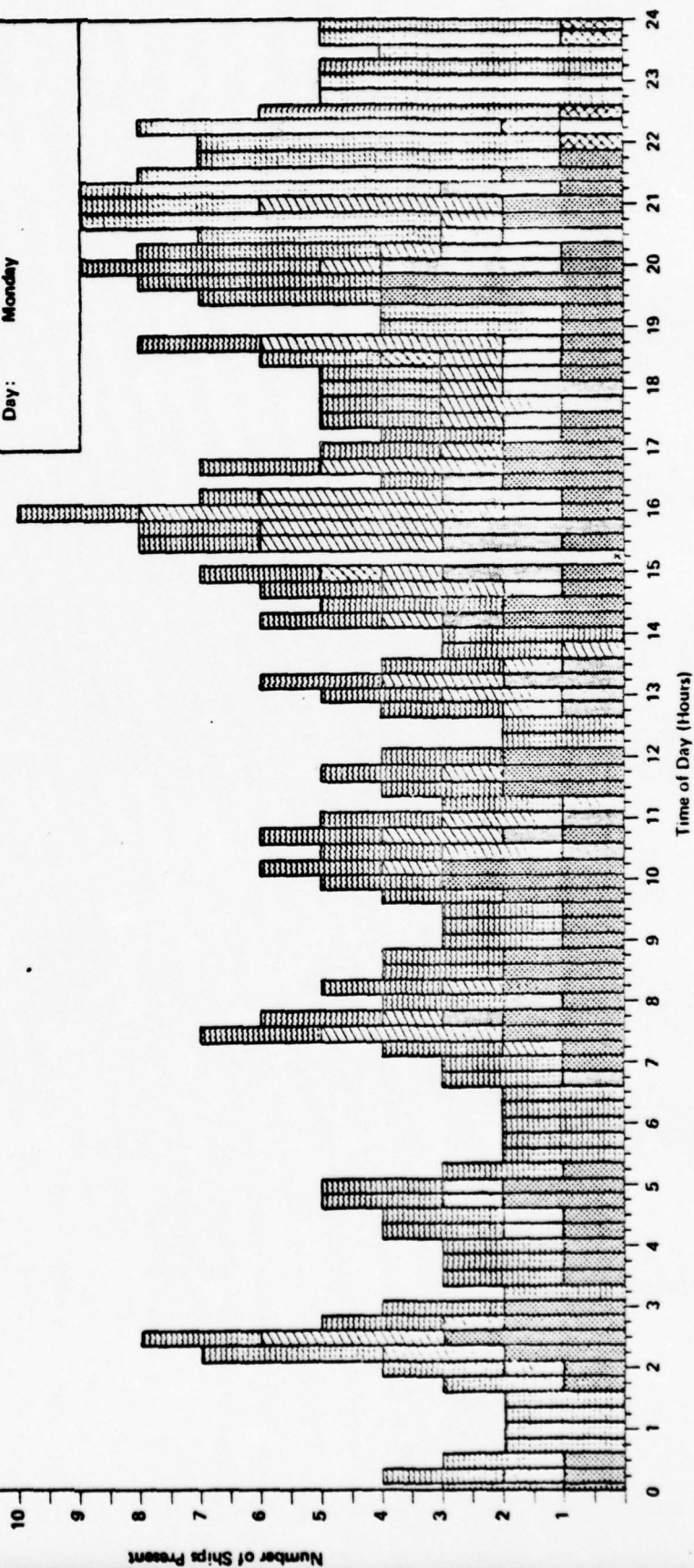


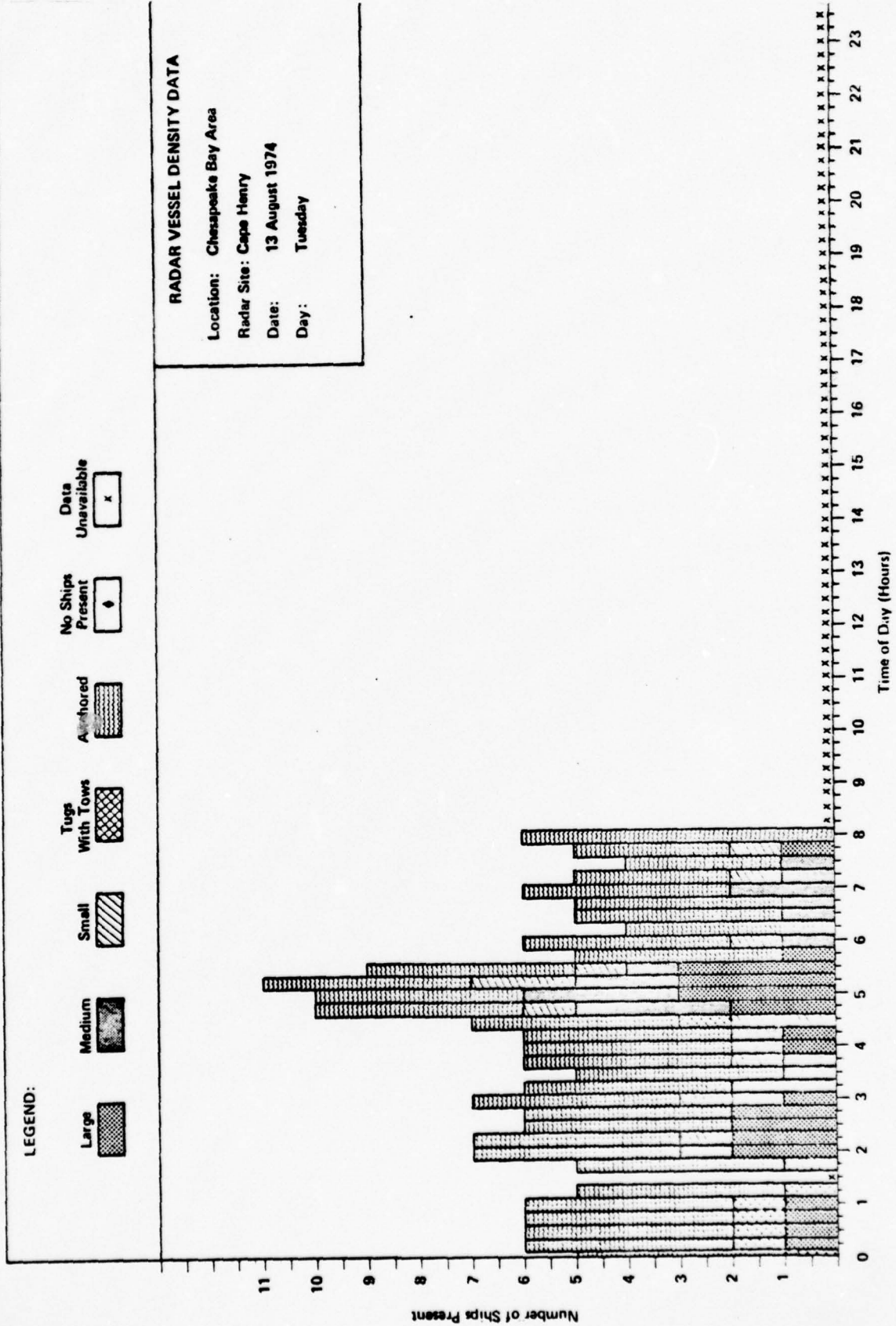
LEGEND:

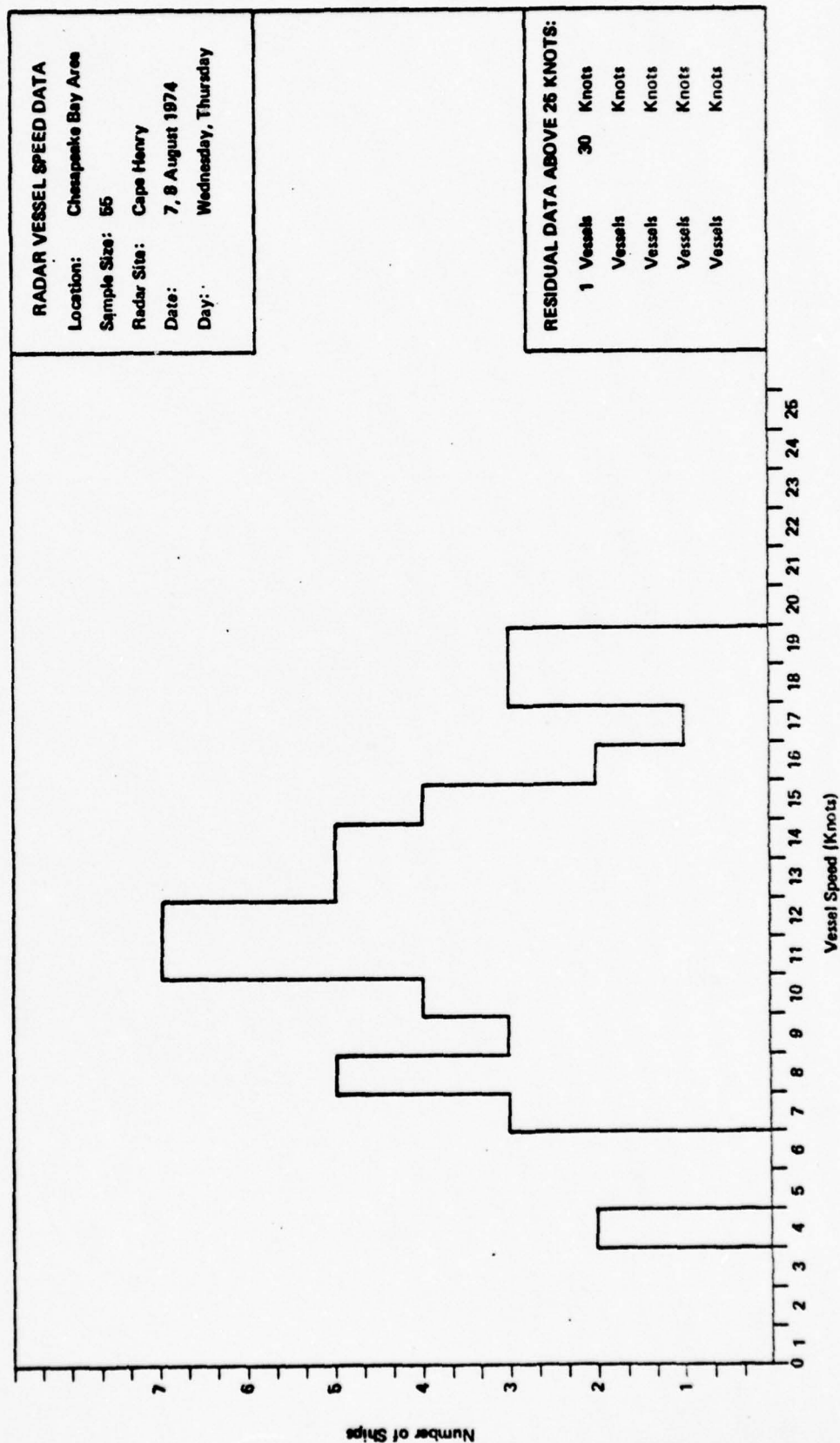


RADAR VESSEL DENSITY DATA

Location: Chesapeake Bay Area
 Radar Site: Cape Henry
 Date: 12 August 1974
 Day: Monday







SPEED DATA
FOR
CAPE HENRY

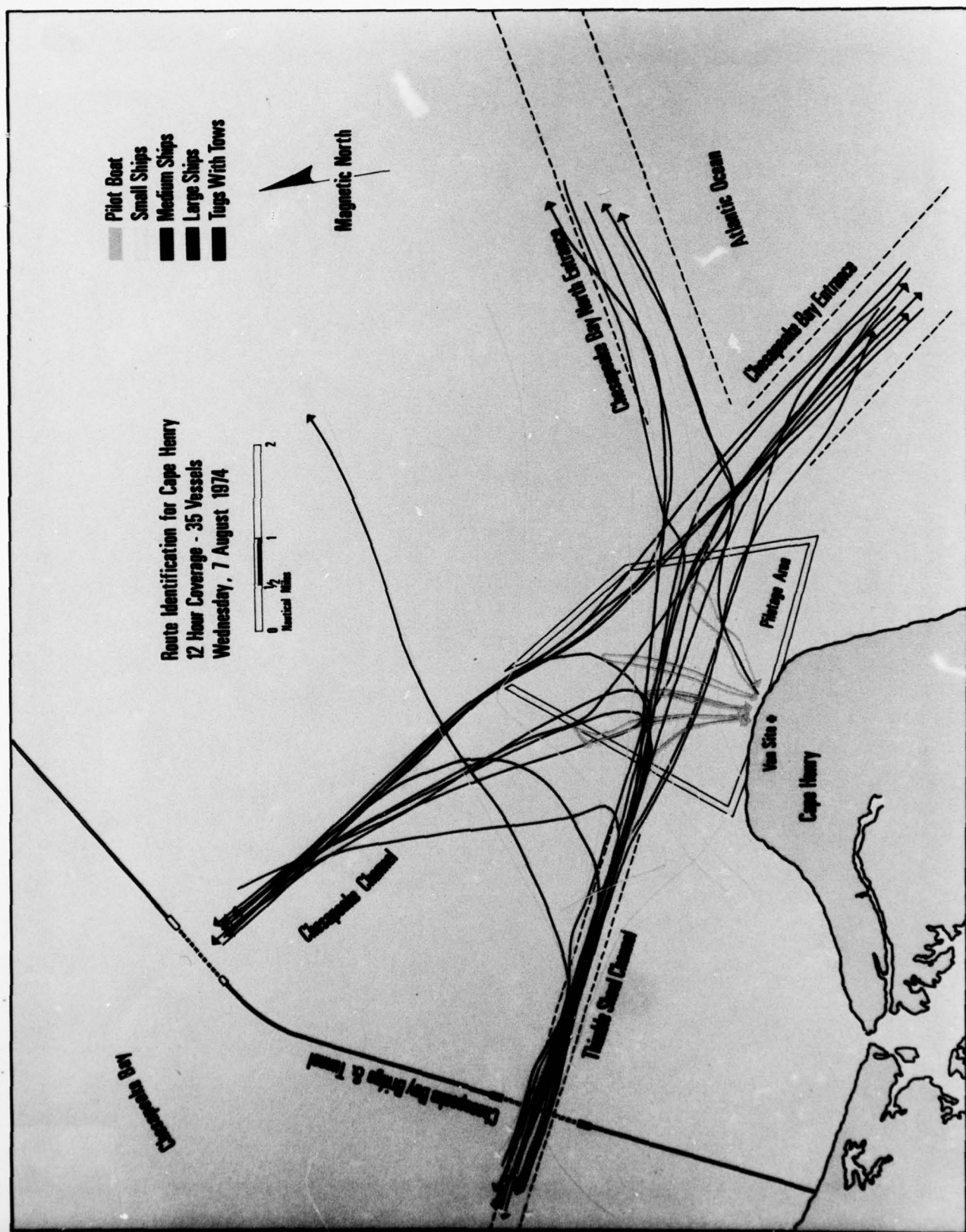
Vessel No.	Vessel Size	Average Speed in Knots	Location*	Direction	Day	Time Hour/Minute	
1	medium	15	TSC	SE	7 August 1974 Wednesday	21	40
2	medium	14	CBE	SE		21	48
3	medium	12	TSC	NW		21	51
4	large	16	TSC	SE		22	09
5	small	9	TSC	NW		22	12
6	large	15	NCBE	East		22	17
7	tug with tow	7	CBE	NW	8 August 1974 Thursday	23	18
8	tug with tow	8	CC	NW		00	04
9	tug with tow	4	CC	SE		00	06
10	medium	12	TSC	SE		00	16
11	medium	11	NCBE	East		00	26
12	large	12	CC	SE		00	27
13	tug	4	CBE	SE		01	02
14	large	19	CC	NW		02	46
15	large	14	CC	SE		02	52
16	medium	7	CBE	NW		03	03
17	large	17	TSC	NW		03	21
18	medium	8	CC	NW		03	46
19	large	11	CC	SE		04	16
20	large	10	CBE	SE		04	34
21	large	7	CBE	NW		05	24
22	large	15	CC	SE		06	16
23	large	12	TSC	NW		06	17
24	large	8	CC-TSC	South		06	29
25	large	11	CBE	NW		06	38
26	large	13	TSC	NW		06	52
27	large	13	CC	SE		06	52

*TSC = Thimble Shoal Channel
 CC = Chesapeake Channel
 CBE = Chesapeake Bay Entrance
 NCBE = North Chesapeake Bay Entrance
 CC-TSC = Chesapeake Channel to Thimble Shoal Channel

SPEED DATA
FOR
CAPE HENRY (CONT)

Vessel No.	Vessel Size	Average Speed in Knots	Location*	Direction	Day	Time Hour/Minute	
28	large	30	CC-TSC	South	8 August 1974 Thursday ↓	07	07
29	large	11	TSC	NW		07	13
30	large	17	CC	SE		10	02
31	large	13	CC-TSC	South		10	13
32	large	19	TSC	NW		10	28
33	large	8	TSC	SE		11	07
34	medium	13	CC	SE		11	15
35	medium	12	CC	SE		11	19
36	large	9	CBE	SE		11	23
37	medium	10	CBE	SE		11	35
38	large	11	CC	SE		11	38
39	large	9	CBE	SE		11	55
40	large	14	TSC	NW		12	13
41	large	11	TSC	SE		13	00
42	medium	18	NCBE	West		13	51
43	large	10	NCBE	West		13	55
44	medium	19	TSC	NW		14	11
45	large	14	CC	NW		14	26
46	large	11	TSC	SE		16	59
47	large	10	CBE	SE		17	11
48	large	13	TSE	SE		18	25
49	large	10	CBE	SE		18	35
50	large	15	CBE	NW		20	41
51	large	18	CC	NW		21	01
52	large	12	CBE	NW		21	17
53	large	16	CC	SE		21	30
54	large	8	CC-TSC	South		21	43
55	large	19	TSC	NW		22	06

*TSC = Thimble Shoal Channel
 CC = Chesapeake Channel
 CBE = Chesapeake Bay Entrance
 NCBE = North Chesapeake Bay Entrance
 CC-TSC = Chesapeake Channel to Thimble Shoal Channel



CLOSE ENCOUNTER DATA
FOR
CAPE HENRY

No.	Day	Time Hour/Minute		Distance Yards	Size	Manner of Approach*
1	Thursday 7 August 1974	02	27	100	2 small	C
2		02	27	200	1 large, 1 small	C
3		02	27	100	1 large, 1 small	P
4		03	03	<50	1 large, 1 small	C
5		04	20	200	2 medium	P
		05	20	} No Data Available		
		05	29			
6		05	53	<50	1 large, 1 small	C
7		06	21	<75	1 large, 1 small	C
8		06	44	<50	1 large, 1 small	C
9		07	33	<50	1 large, 1 small	C
10		07	38	<75	1 large, 1 small	C
11		08	55	<95	1 large, 1 small	C
12		09	20	200	1 large, 1 small	P
13		09	24	290	2 large	P
14		09	25	120	1 large, 1 small	P
15		09	34	<95	1 large, 1 small	C
16		09	35	290	1 small, 1 medium	O
		09	54	} No Data Available		
		10	52			
17		12	50	230	1 tug, 1 large	C
18		14	41	<50	1 large, 1 small	C
19		14	58	240	1 tug, 1 medium	P
		16	18	} No Data Available		
		16	26			
20		17	31	<95	1 large, 1 small	C
21		17	53	200	1 large, 1 small	P
22		18	02	<95	1 large, 1 small	C

*P = Passing
O = Overtaking
C = Crossing

< = less than

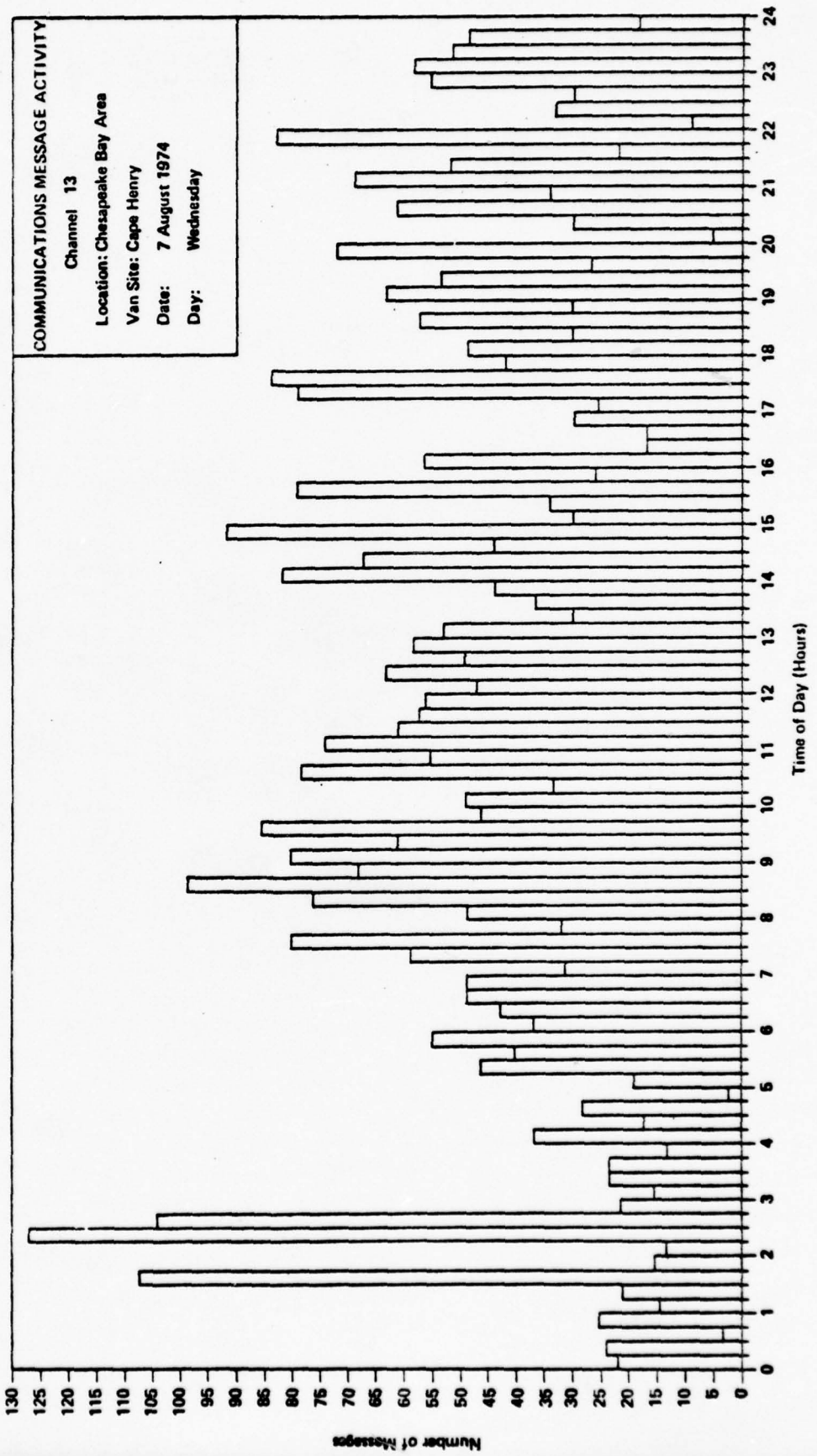
CLOSE ENCOUNTER DATA
FOR
CAPE HENRY (CONT)

No.	Day	Time Hour/Minute		Distance Yards	Size	Manner of Approach*
23	Thursday 7 August 1974	19	50	<95	1 large, 1 small	C
24		20	25	<95	1 large, 1 small	C
25		20	53	<100	1 large, 1 small	C
26		20	54	<100	1 large, 1 small	C
27		20	56	<100	1 large, 1 small	P
28		21	00	<100	1 large, 1 small	P
29		21	16	<95	1 large, 1 small	P
		21	17	} No Data Available		
		21	26			
30	Friday 8 August 1974	21	33	<75	1 large, 1 small	C
31		21	58	<100	1 large, 1 small	C
32		22	16	280	1 medium, 1 large	P
33		23	49	<50	1 tug, 1 small	C
34		00	23	240	2 tugs	P
35		00	28	300	1 large, 1 tug	P
36		00	36	<95	1 large, 1 small	C
37		00	47	<95	1 large, 1 small	C

37 close encounters out of 76 encounters
in a 23-hour period.

*P = Passing
O = Overtaking
C = Crossing

< = less than



COMMUNICATIONS CHANNEL EFFICIENCY

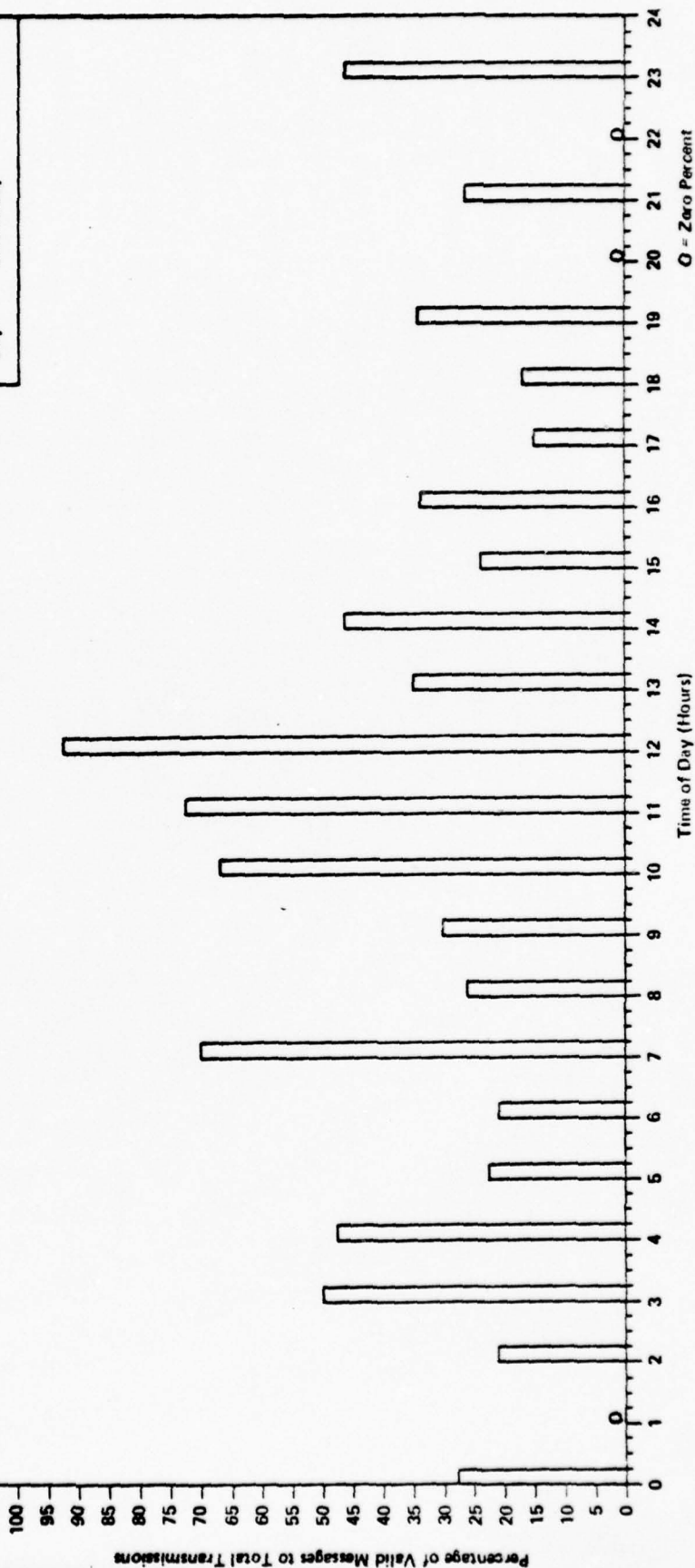
Channel 13

Location: Chesapeake Bay Area

Van Site: Cape Henry

Date: 7 August 1974

Day: Wednesday



COMMUNICATIONS CHANNEL
UTILIZATION

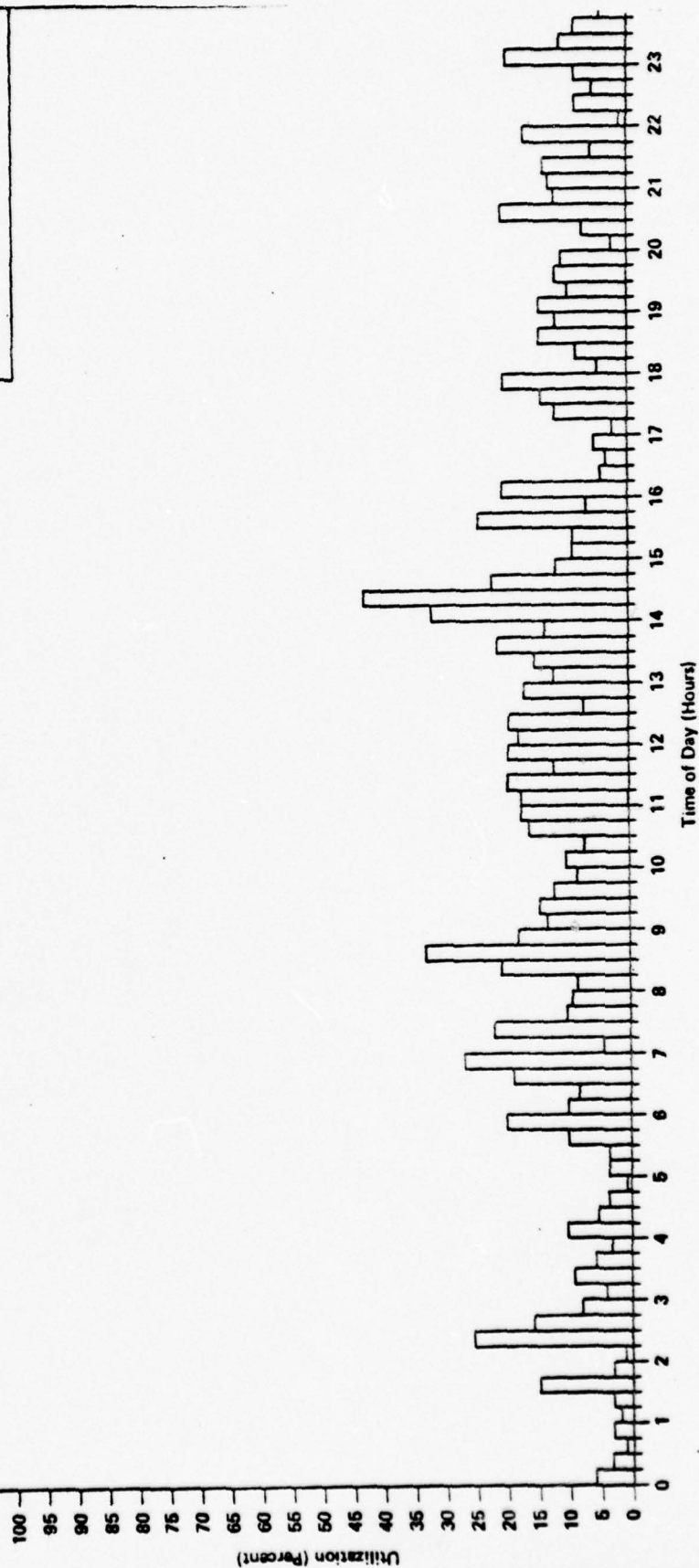
Channel 13

Location: Chesapeake Bay Area

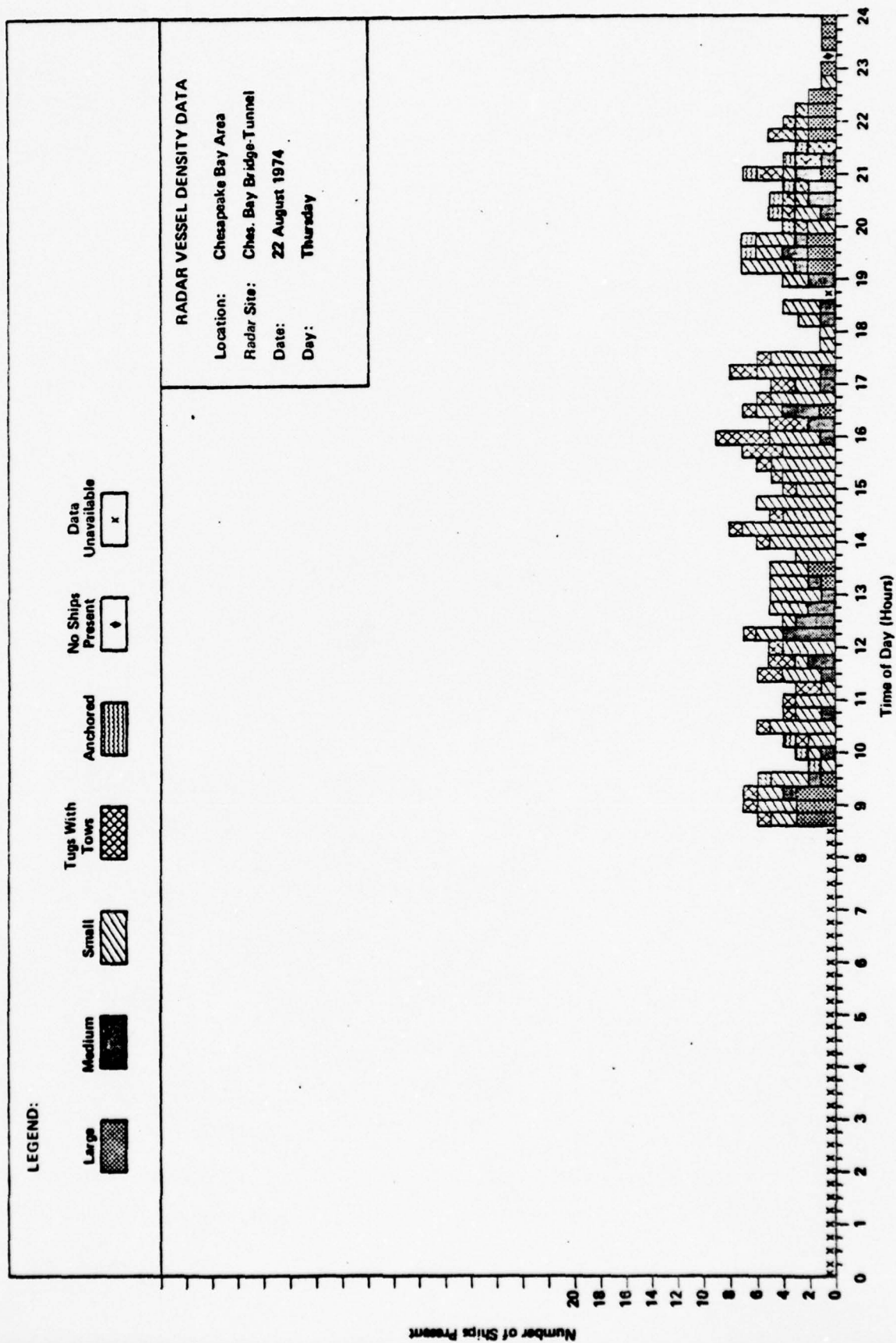
Van Site: Cape Henry

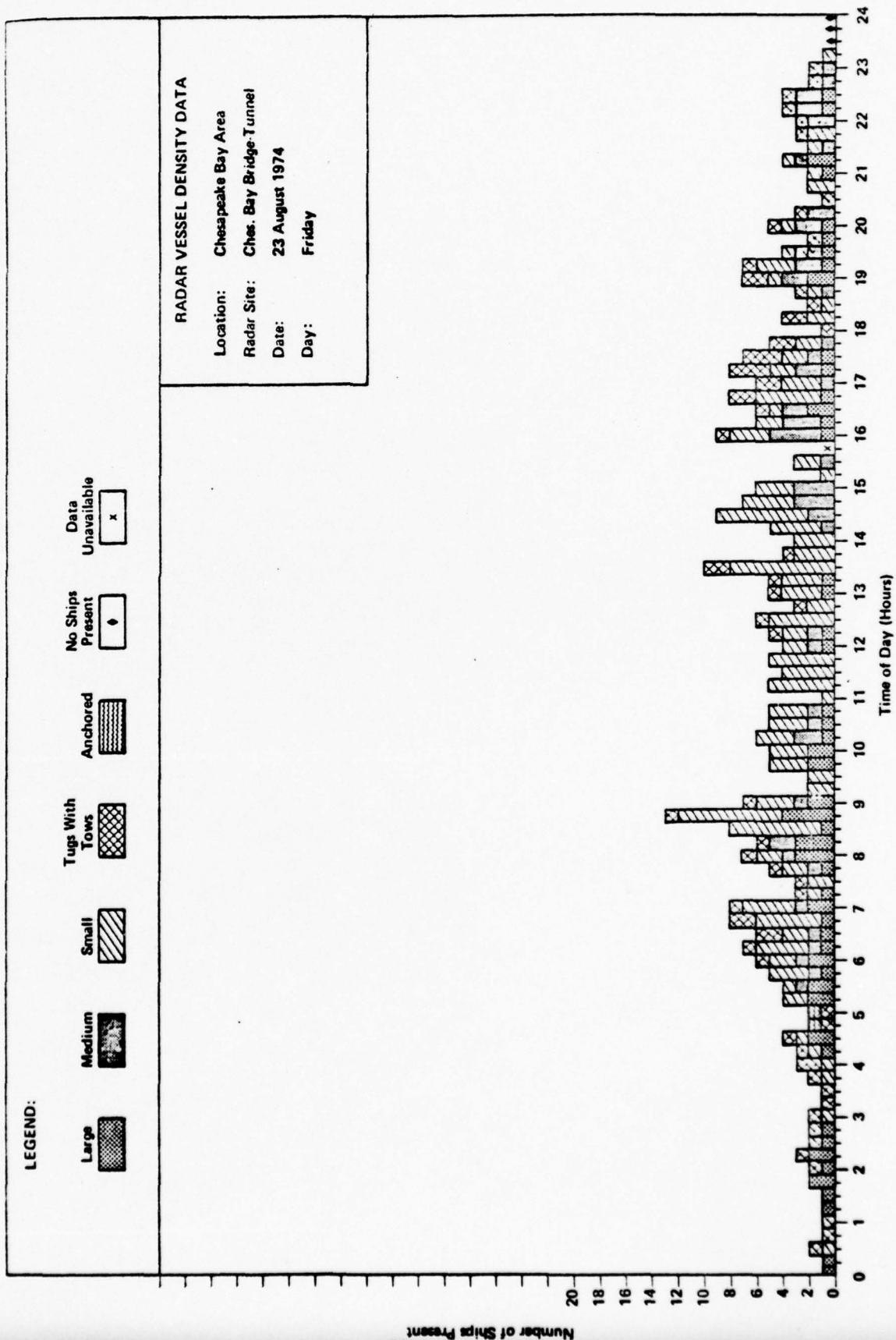
Date: 7 August 1974

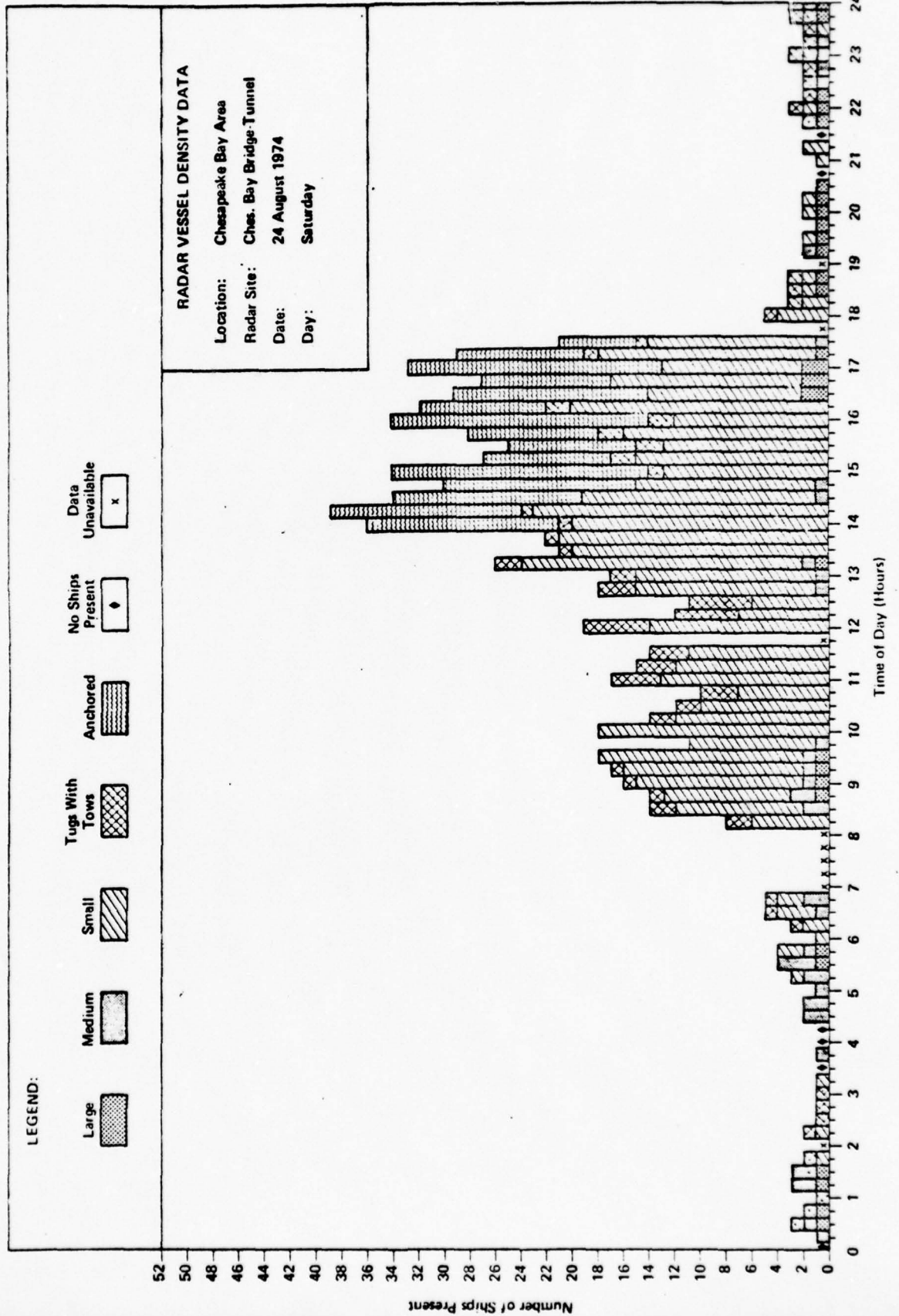
Day: Wednesday



2.2 DATA FROM CHESAPEAKE BAY BRIDGE AND TUNNEL



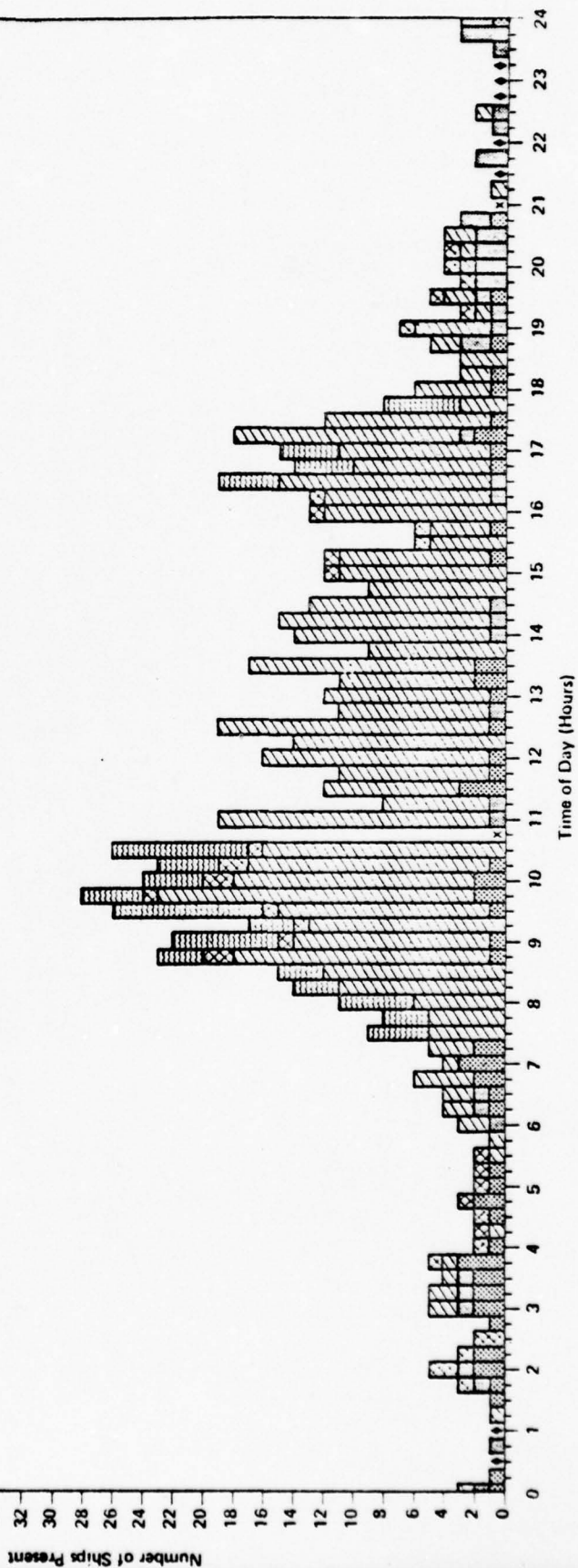




Large	Medium	Small	Tugs With Tows	Anchored	No Ships Present	Data Unavailable

RADAR VESSEL DENSITY DATA

Location:	Chesapeake Bay Area
Radar Site:	Ches. Bay Bridge Tunnel
Date:	25 August 1974
Day:	Sunday



LEGEND:



Large



Medium



Small



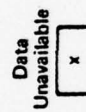
Tugs With
Tows



Anchored



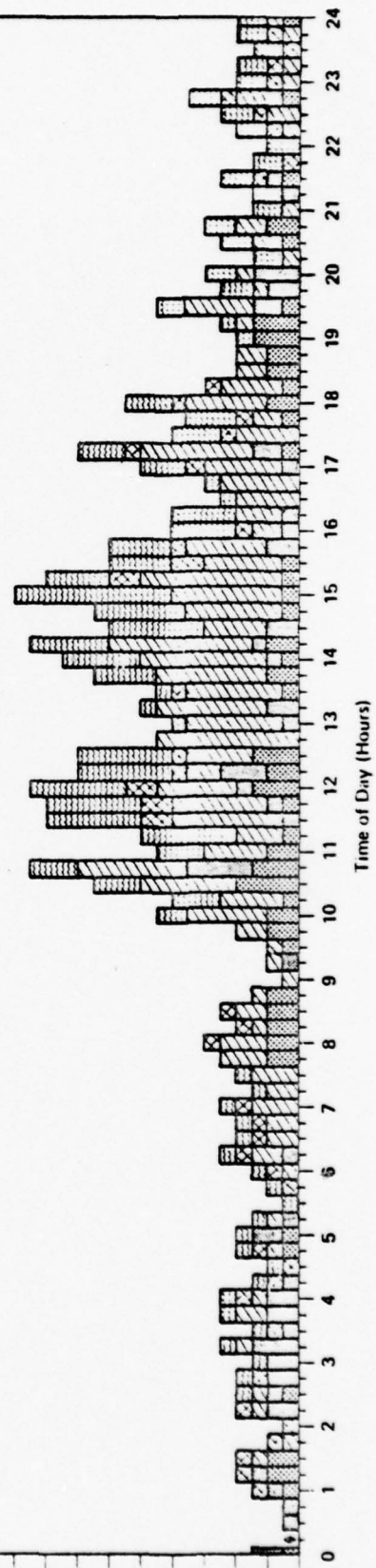
No Ships
Present



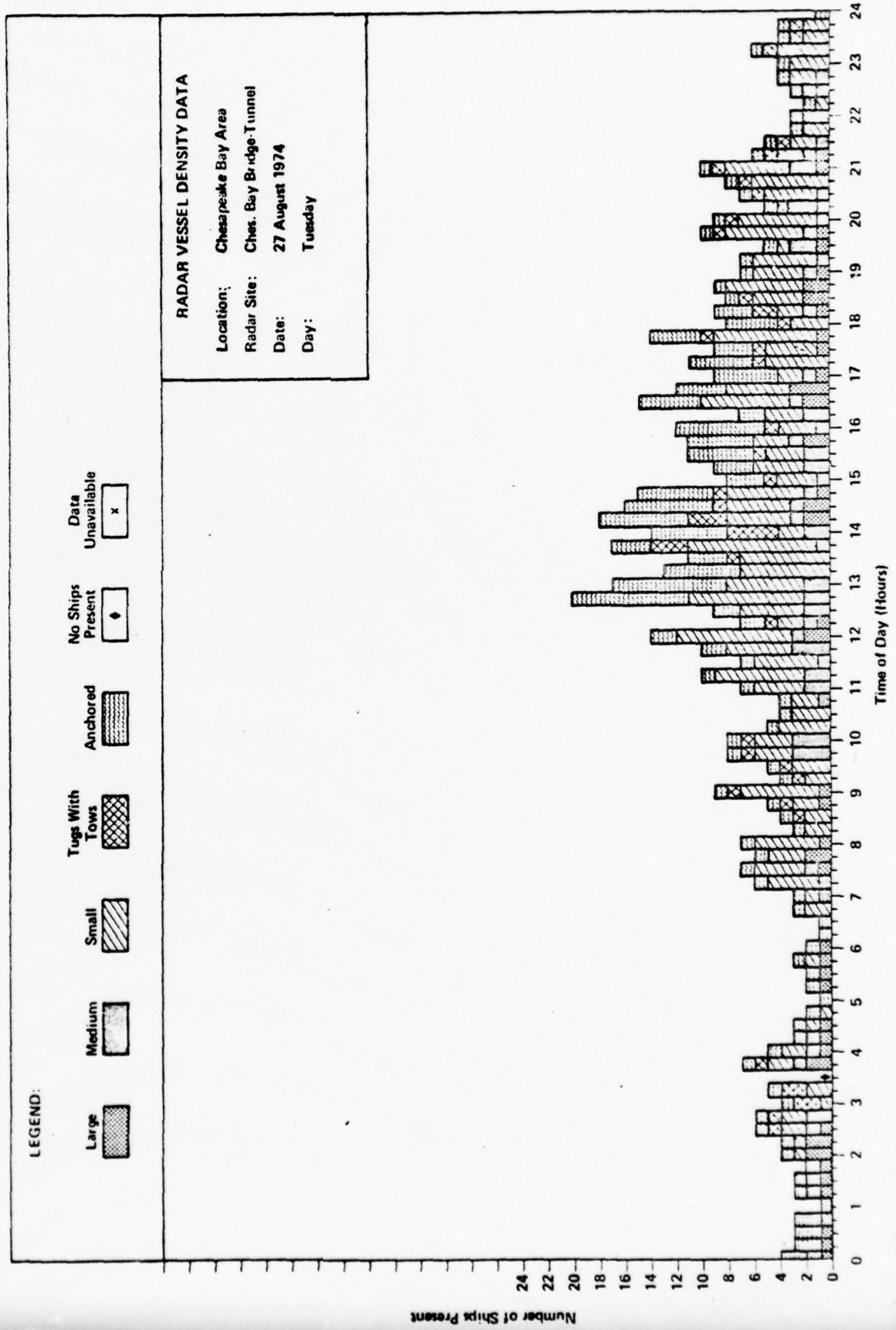
Data
Unavailable

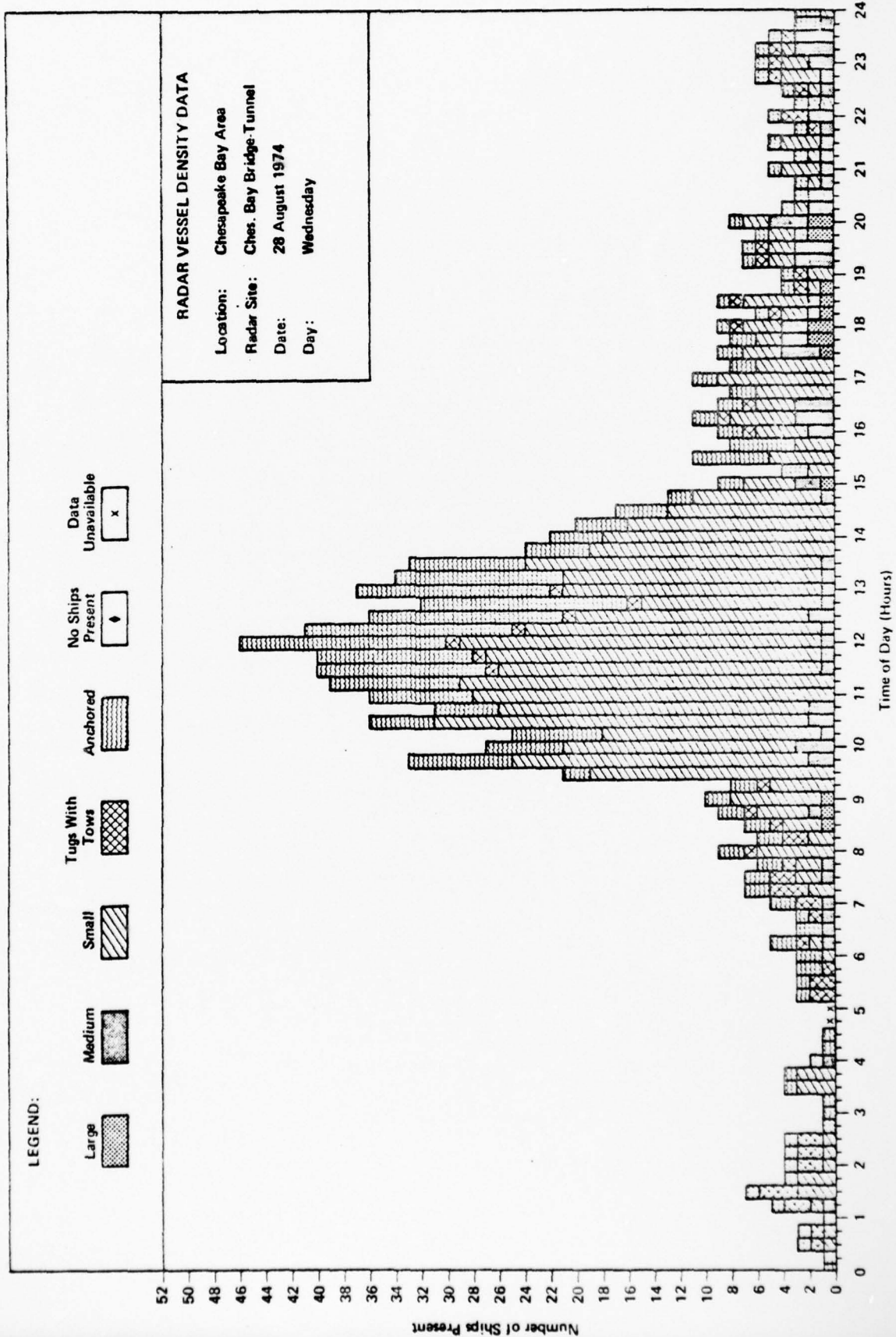
RADAR VESSEL DENSITY DATA

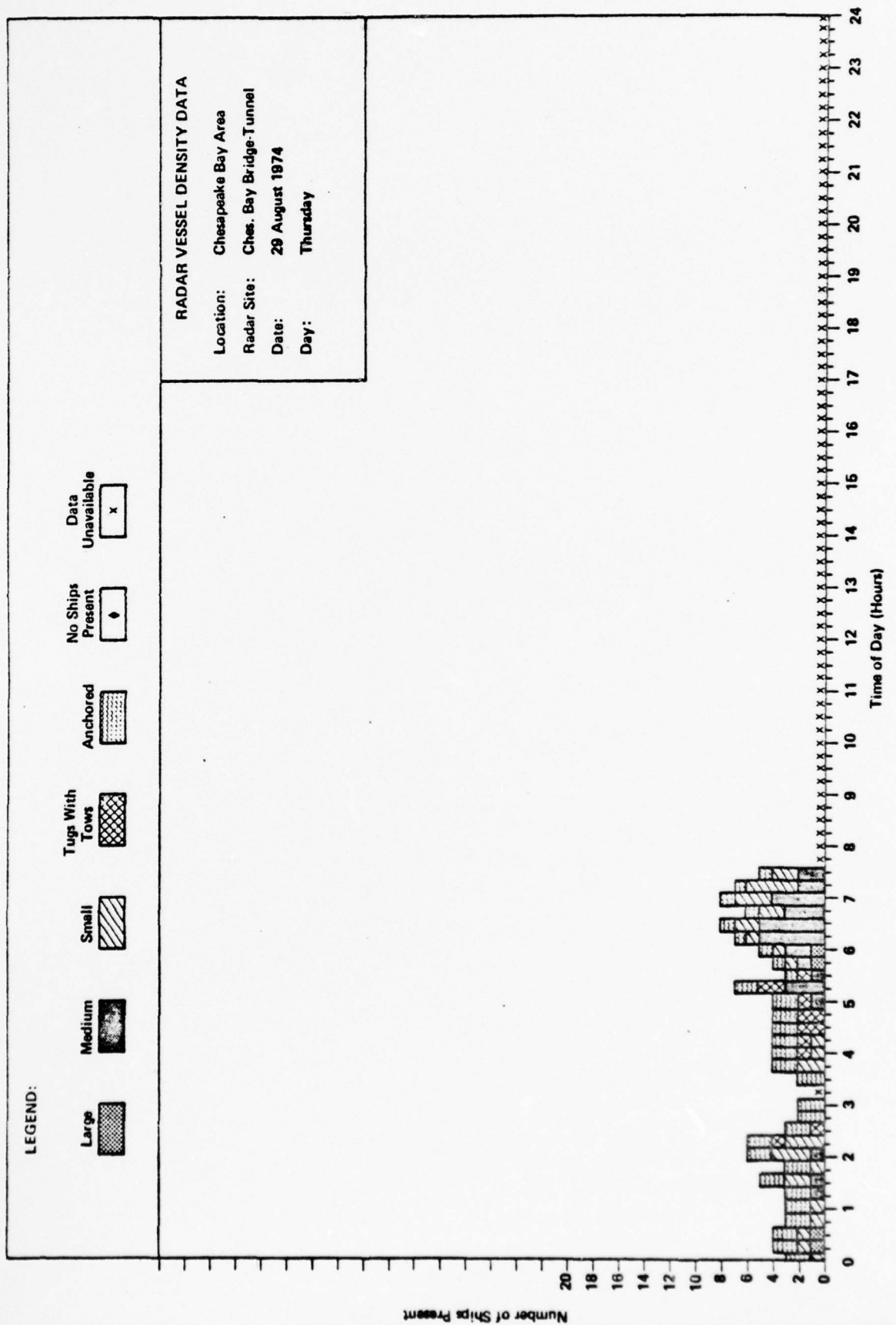
Location: Chesapeake Bay Area
Radar Site: Ches. Bay Bridge-Tunnel
Date: 26 August 1974
Day: Monday

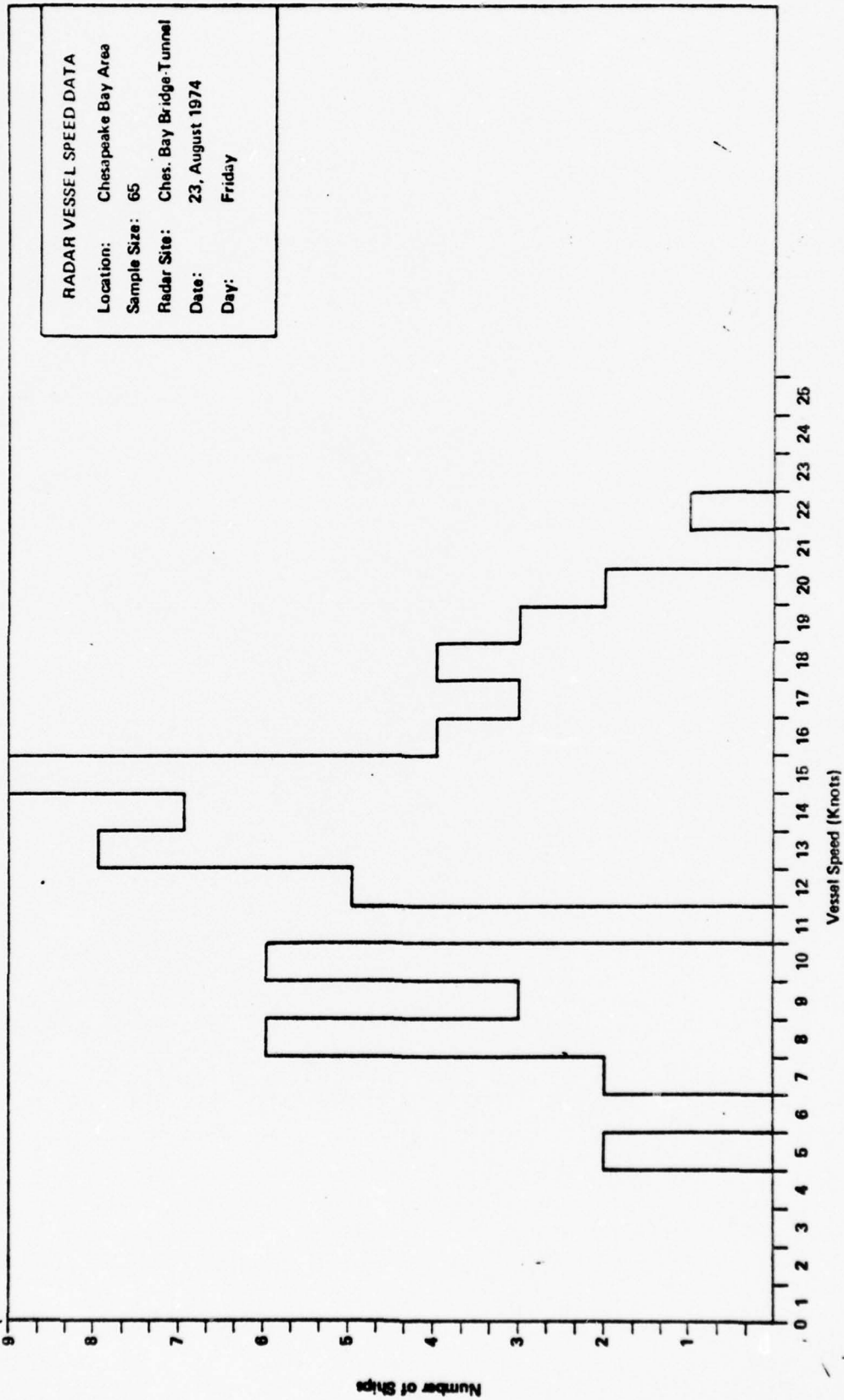


Time of Day (Hours)









SPEED DATA
FOR
CHESAPEAKE BAY BRIDGE AND TUNNEL

Vessel No.	Vessel Size	Average Speed in Knots	Location*	Direction	Day	Time Hour/Minute	
1	large	12	A	NW	22 August 1974 Thursday ↓	08	40
2	medium	12	A	NW		08	53
3	tug with tow	10	B	NW		08	51
4	small	10	A	SE		09	49
5	small	8	A	SE		10	29
6	small	14	B	NW		11	31
7	small	20	A	SE		11	32
8	small	14	A	NW		11	57
9	large	17	A	NW		13	01
10	large	10	A	SE		13	51
11	small	14	A	SE		14	54
12	large	15	A	SE		15	29
13	large	15	B	NW		15	50
14	small	10	B	SE		16	52
15	large	14	A	NW		19	09
16	medium	14	B	NW		19	32
17	medium	15	A	SE		20	14
18	large	16	B	SE		21	43
19	large	8	B	NW		21	53
20	medium	12	A	NW		21	58
21	medium	20	B	NW		22	55
22	medium	17	A	NW		23	26
23	tug with tow	9	B	NW	23 August 1974 Friday ↓	00	27
24	medium	15	A	SE		01	10
25	large	19	B	SE		01	37
26	large	14	B	NW		02	01
27	large	16	B	NW		02	17

*A = Thimble Shoal Channel
B = Chesapeake Channel

SPEED DATA
FOR
CHESAPEAKE BAY BRIDGE AND TUNNEL (CONT)

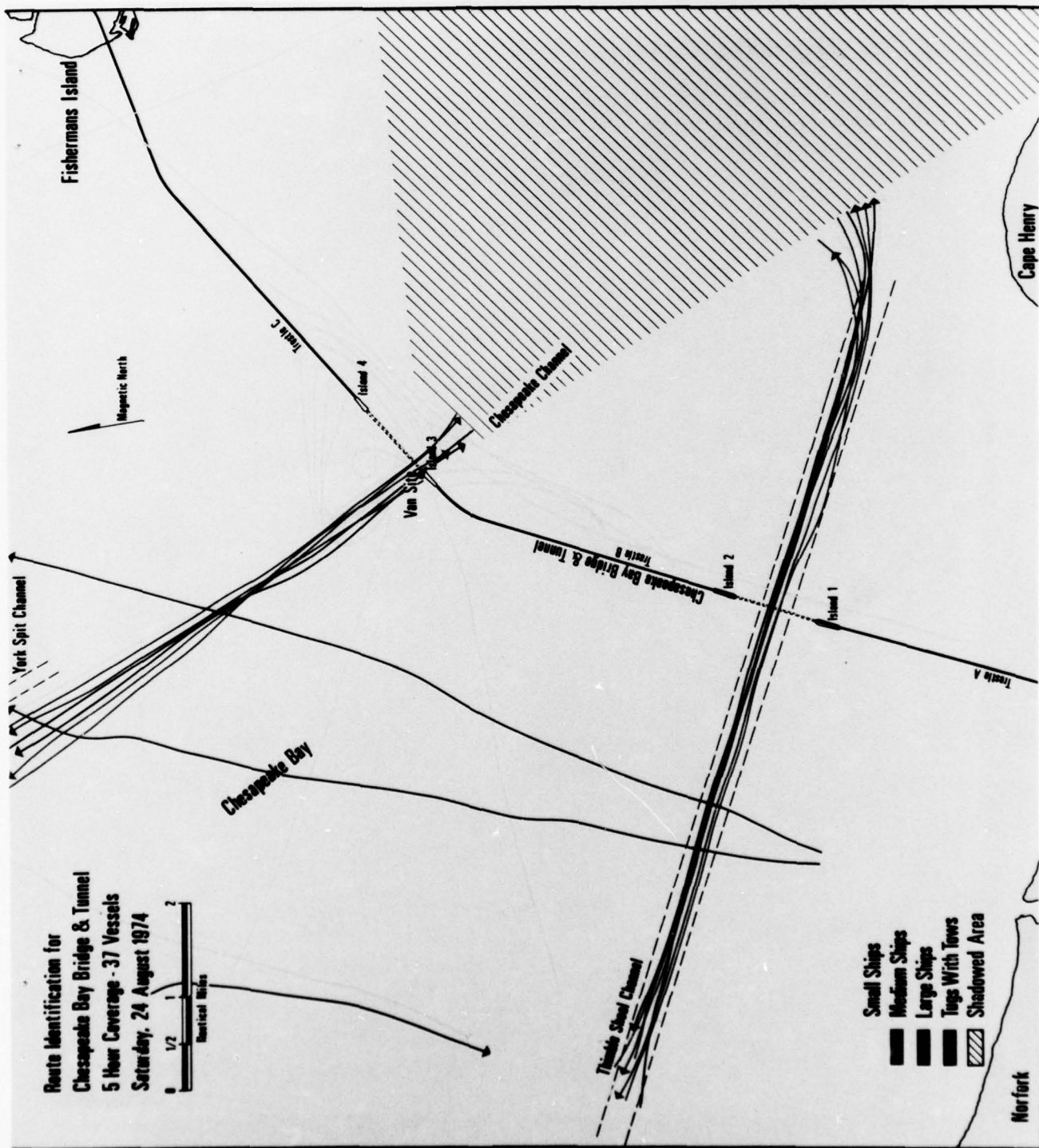
Vessel No.	Vessel Size	Average Speed in Knots	Location*	Direction	Day	Time Hour/Minute	
28	medium	18	B	SE	23 August 1974 Friday	02	36
29	tug with tow	5	B	SE		04	04
30	large	19	B	SE		04	20
31	small	5	A	NW		05	41
32	large	17	B	SE		06	57
33	medium	16	B	NW		07	45
34	large	14	A	NW		07	51
35	small	8	A	SE		12	30
36	large	15	B	NW		13	01
37	medium	12	B	SE		14	30
38	large	15	B	NW		17	11
39	large	16	A	SE		20	08
40	medium	13	A	SE		21	02
41	large	13	B	NW	24 August 1974 Saturday	22	05
42	medium	18	A	SE		22	35
43	medium	13	A	NW		00	07
44	tug with tow	9	B	SE		06	15
45	large	15	A	NW		11	59
46	medium	8	B	SE		12	36
47	large	18	B	NW		13	04
48	small	7	B	SE		15	05
49	tug with tow	7	A	NW		15	15
50	small	8	A	SE		15	34
51	small	9	A	SE		15	50
52	large	19	B	NW		14	10
53	large	15	B	NW		20	19
54	large	13	A	NW		21	50

*A = Thimble Shoal Channel
B = Chesapeake Channel

SPEED DATA
FOR
CHESAPEAKE BAY BRIDGE AND TUNNEL (CONT)

Vessel No.	Vessel Size	Average Speed in Knots	Location*	Direction	Day	Time Hour/Minute	
55	large	13	B	NW	24 August 1974 Saturday	23	37
56	medium	18	A	NW	25 August 1974 Sunday	08	31
57	medium	8	A	NW		08	33
58	tug with tow	12	A	NW		08	37
59	medium	13	A	SE		09	14
60	large	14	A	SE		10	03
61	large	13	B	NW		10	53
62	large	10	A	SE		11	54
63	medium	15	A	NW		12	00
64	medium	10	B	SE		12	36
65	large	22	B	NW		12	59

*A = Thimble Shoal Channel
B = Chesapeake Channel



CLOSE ENCOUNTER DATA
FOR
CHESAPEAKE BAY BRIDGE AND TUNNEL

No.	Day	Time Hour/Minute		Distance Yards	Size	Manner of Approach*
1	Saturday 24 August 1974	08	16	200	2 small	P
2		08	17	200	2 small	P
3		08	17	<200	2 small	P
4		08	17	<200	2 small	P
5		08	17	<200	2 small	O
6		08	18	150	2 small	O
7		08	18	90	2 small	P
8		08	20	150	2 small	C
9		08	21	100	2 small	P
10		08	21	150	2 small	C
11		08	25	280	2 small	P
12		08	26	190	2 small	P
13		08	26	290	2 small	P
14		08	27	160	2 small	C
15		08	27	180	2 small	C
16		08	27	100	2 small	C
17		08	28	<50	2 small	P
18		08	29	210	2 large	O
19		08	30	100	2 small	O
20		08	31	100	2 small	P
21		08	32	180	2 small	C
22		08	32	180	2 small	C
23		08	32	170	2 small	P
24		08	33	170	2 small	P
25		08	33	180	2 small	P
26		08	34	<100	2 small	P
27		08	35	<50	2 small	P
28		08	36	130	2 small	O

*P = Passing
O = Overtaking
C = Crossing

< = less than

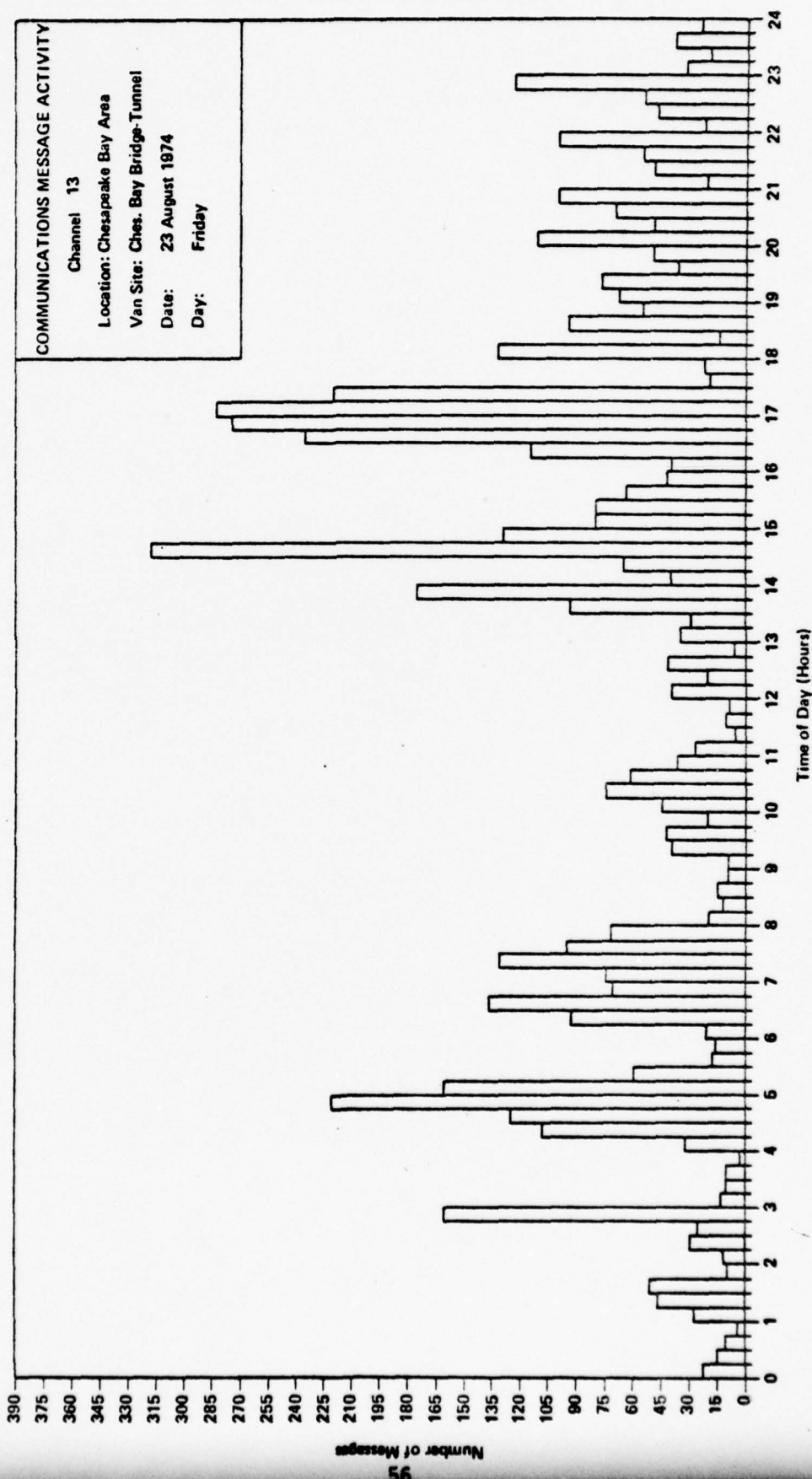
CLOSE ENCOUNTER DATA
FOR
CHESAPEAKE BAY BRIDGE AND TUNNEL (CONT)

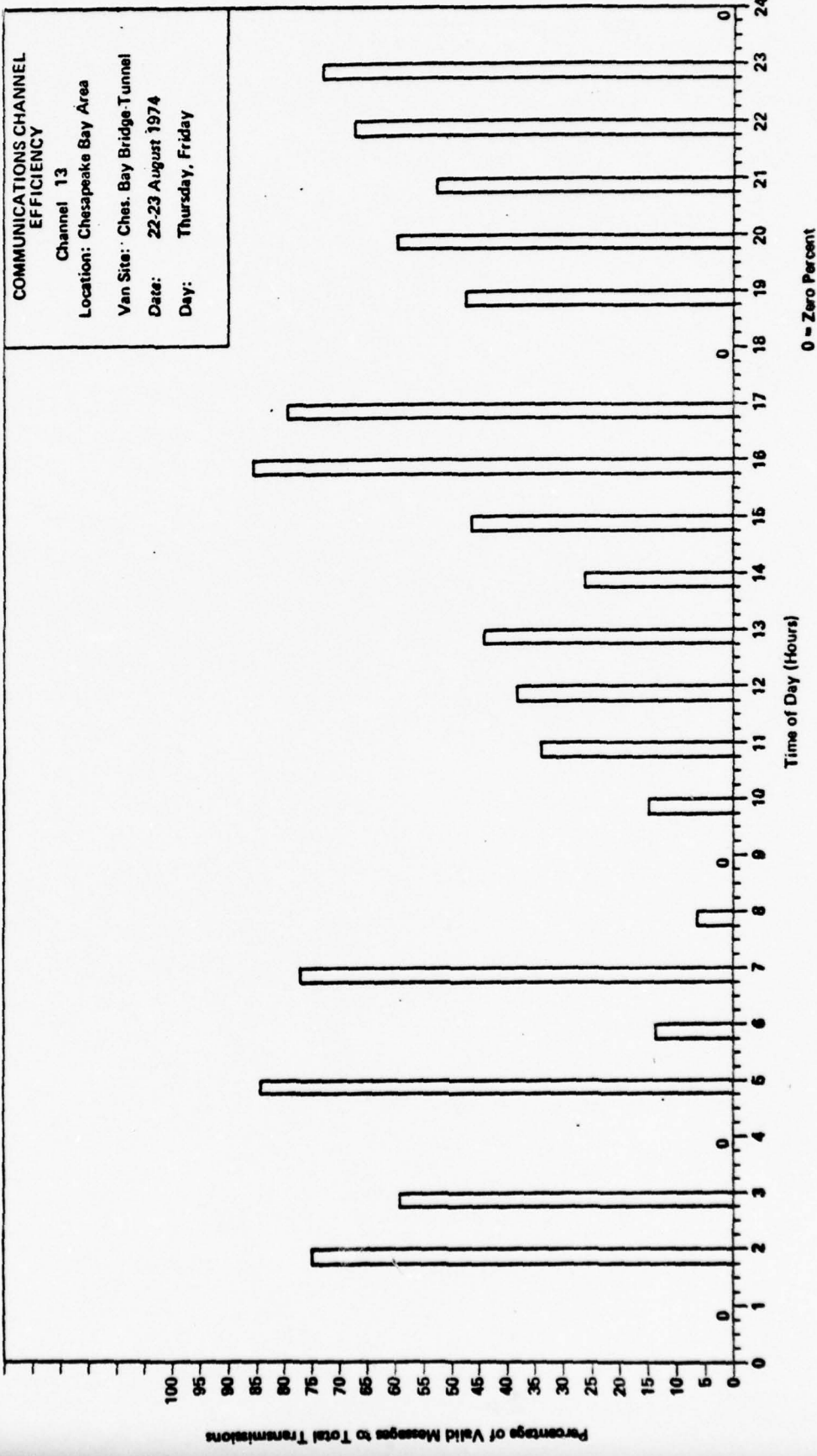
No.	Day	Time Hour/Minute		Distance Yards	Size	Manner of Approach*
29	Saturday 24 August 1974	08	36	300	2 small	C
30		08	37	<100	2 small	P
31		08	37	<40	2 small	P
32		08	38	<50	2 small	P
33		08	38	<50	2 small	P
34		08	38	<50	2 small	O
35		08	38	150	2 small	P
36		08	39	100	2 small	O
37		08	39	<80	2 small	P
38		08	40	<80	2 small	P
39		08	41	<60	2 small	P
40		08	41	<60	2 small	P
41		08	41	<60	2 small	O
42		08	41	<120	2 small	P
43		08	42	140	2 small	P
44		08	42	250	2 small	P
45		08	42	<60	2 small	C
46		08	42	<60	2 small	C
47		08	42	<60	2 small	O
48		08	43	<100	2 small	P

48 close encounters out of 85 encounters during a
30-minute period

*P = Passing
O = Overtaking
C = Crossing

< = less than





COMMUNICATIONS CHANNEL UTILIZATION

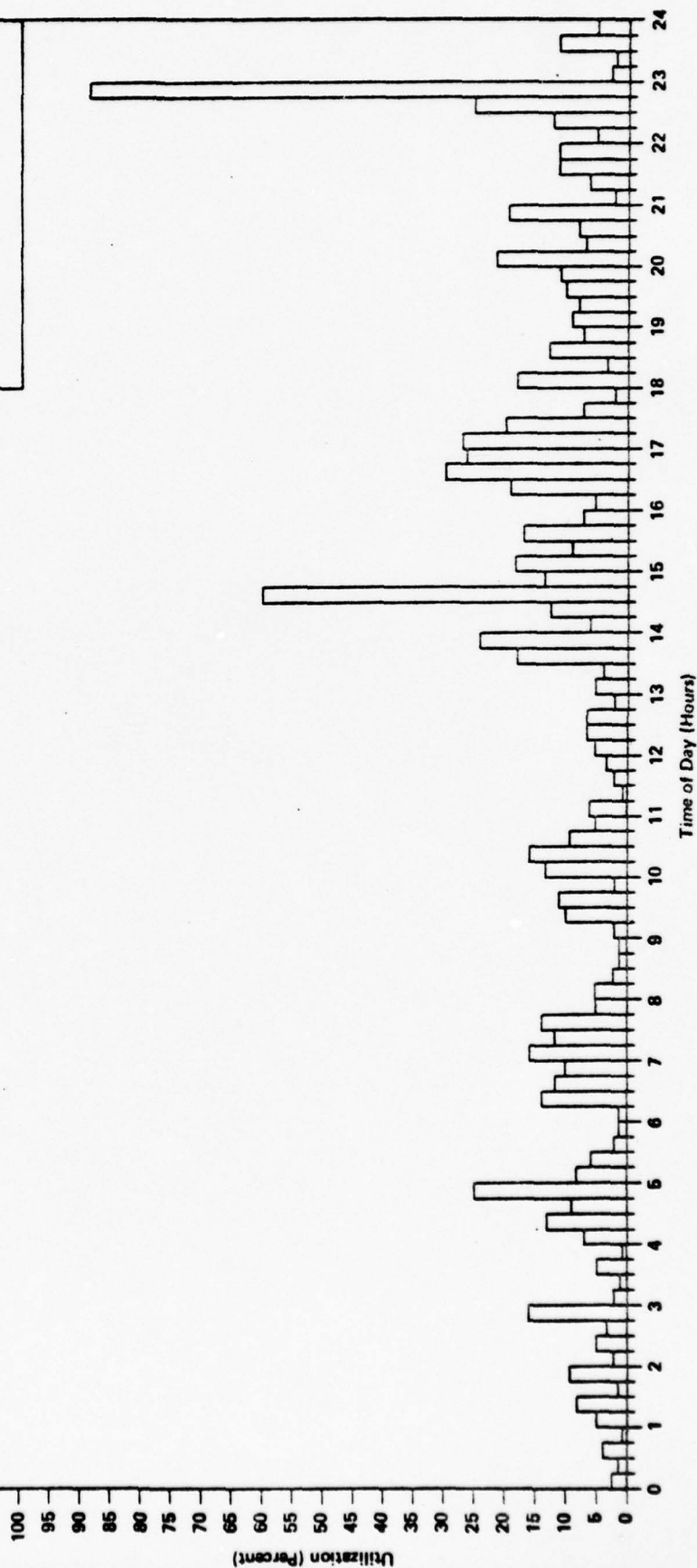
Channel 13

Location: Chesapeake Bay Area

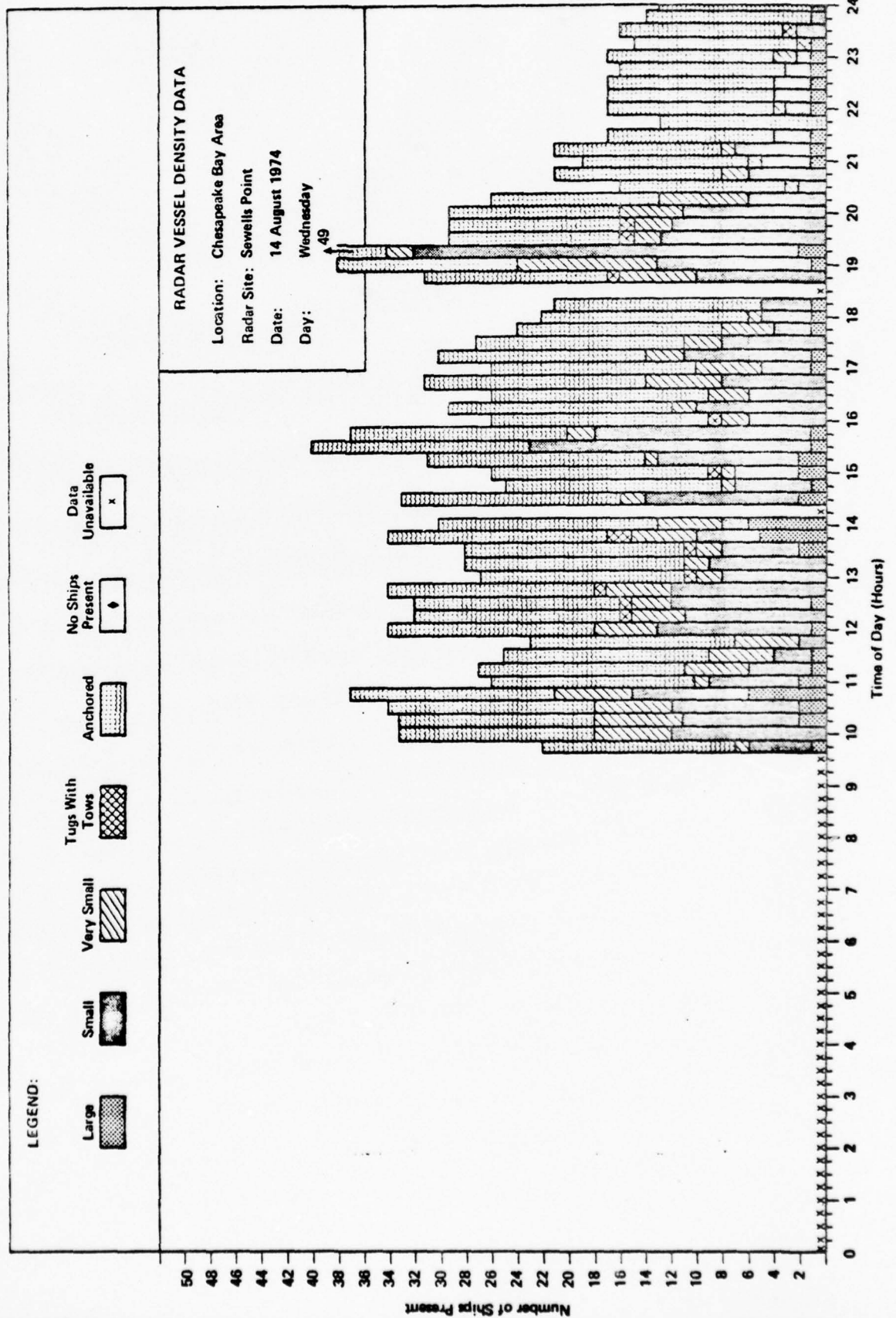
Van Site: Ches. Bay Bridge-Tunnel

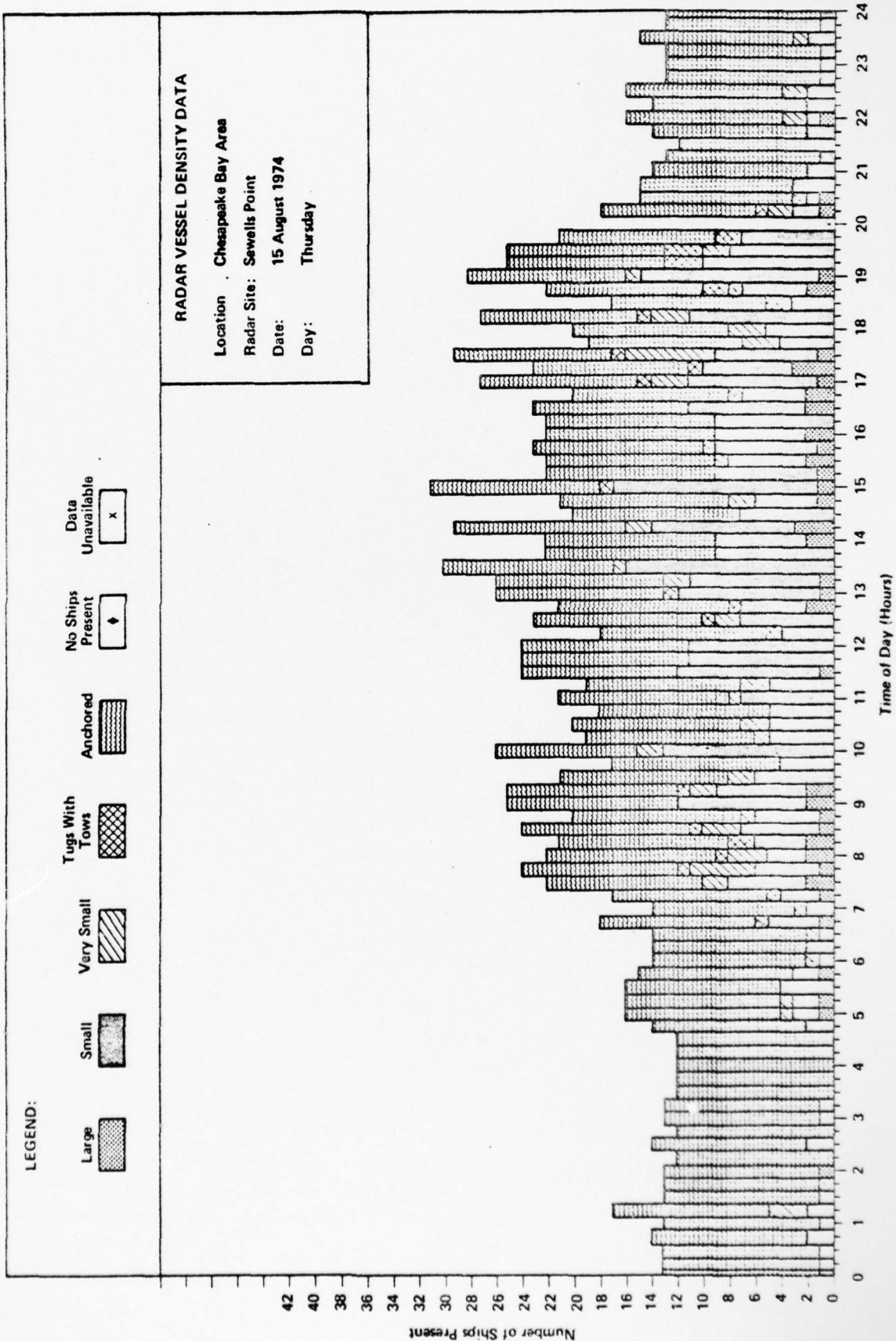
Date: 23 August 1974

Day: Friday



2.3 DATA FROM SEWELLS POINT





LEGEND:

Large

Small

Very Small

Tugs With Tows

Anchored

No Ships Present

Data Unavailable

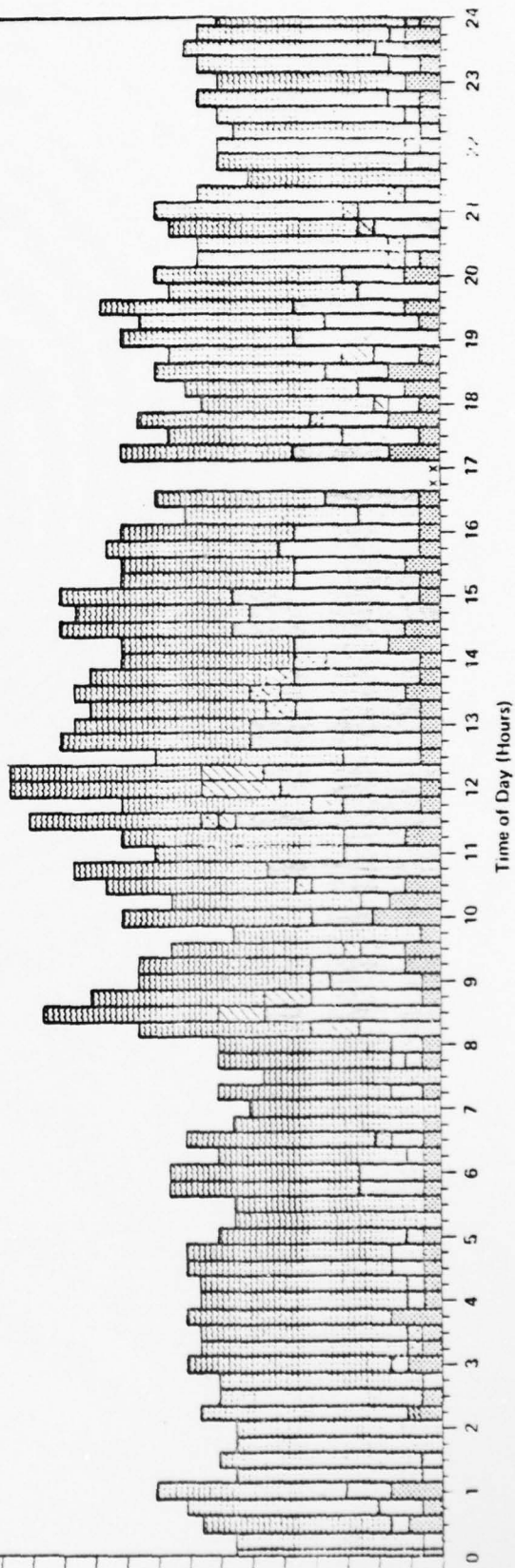
RADAR VESSEL DENSITY DATA

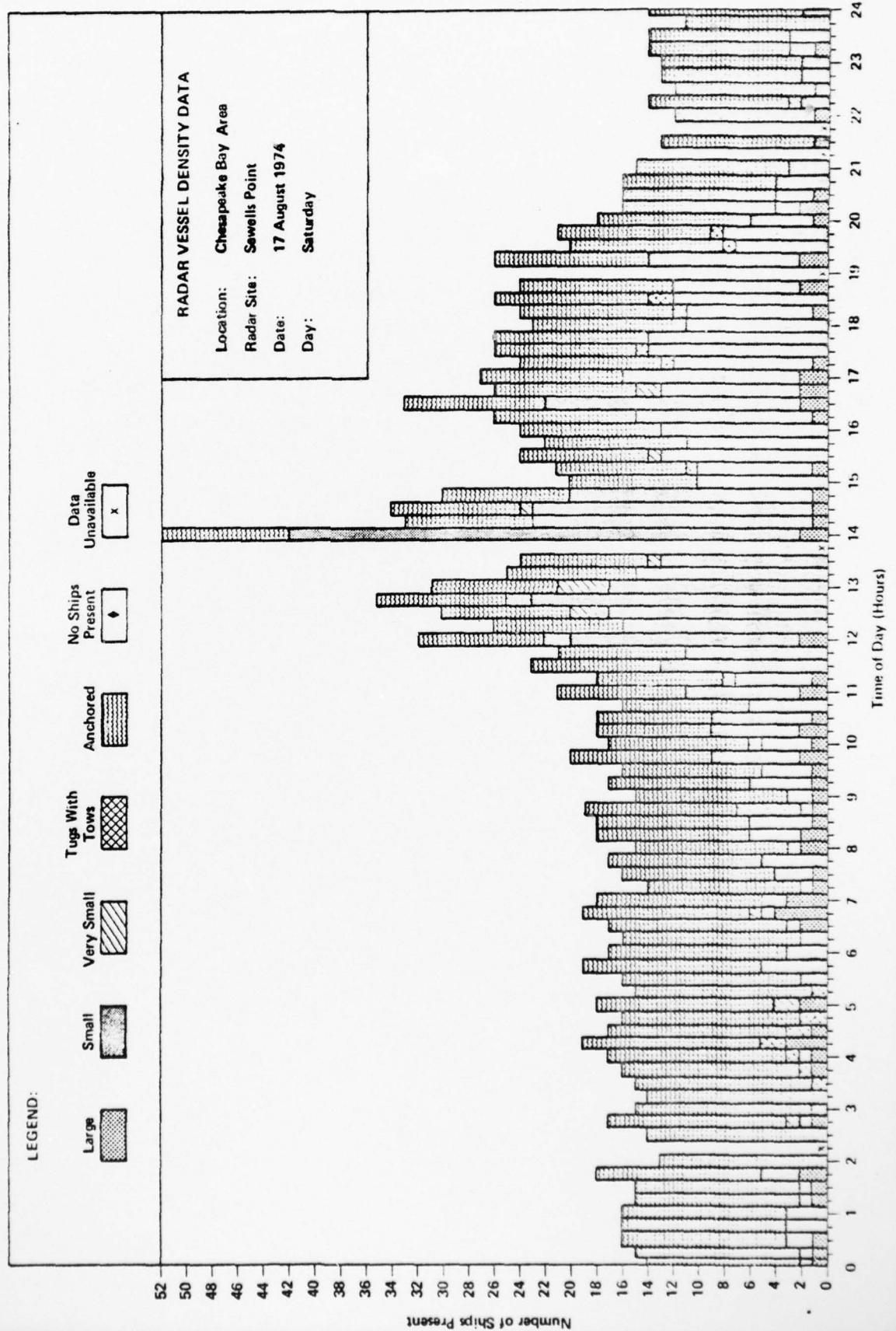
Location: Chesapeake Bay Area

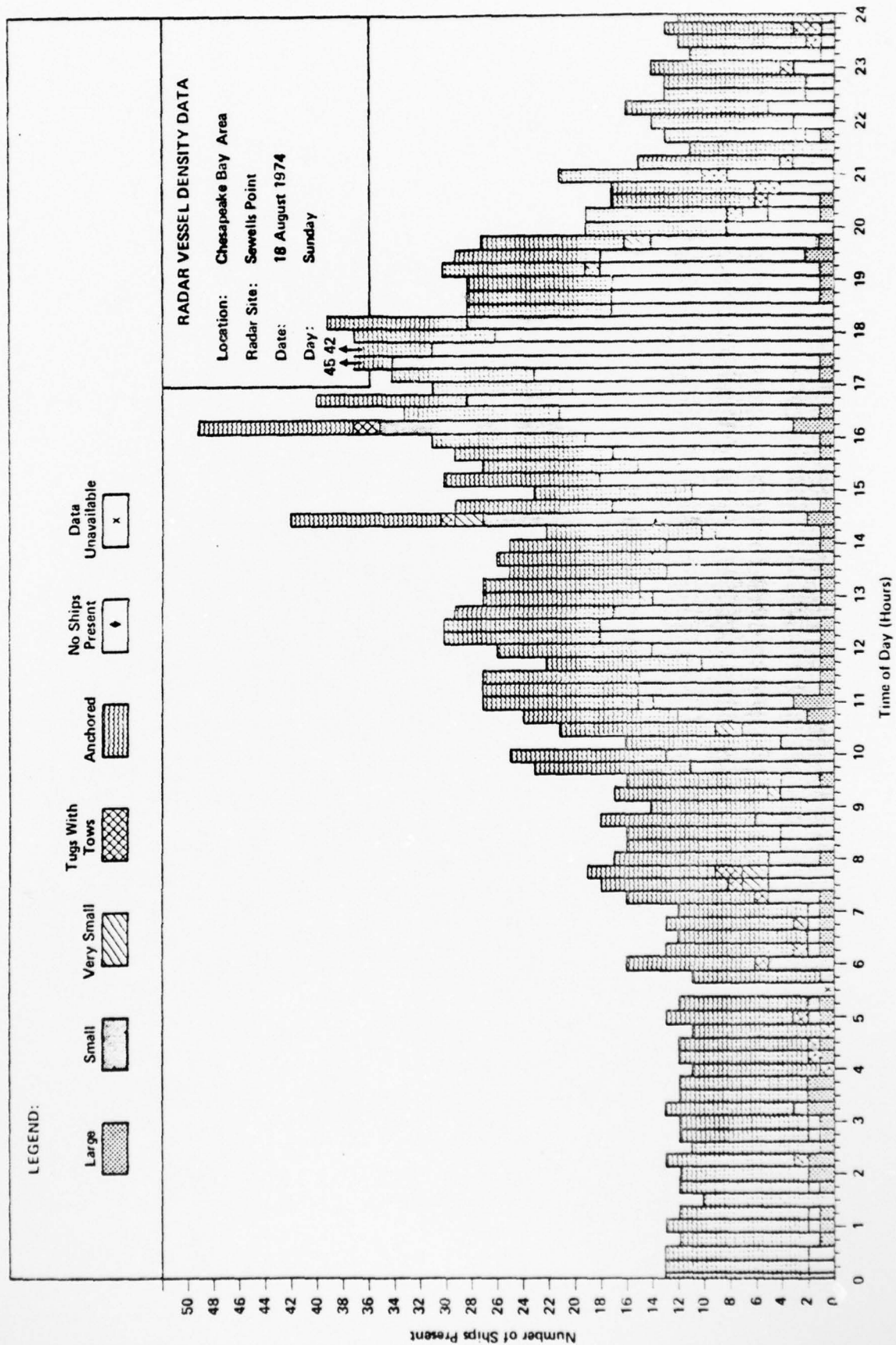
Radar Site: Sewalls Point

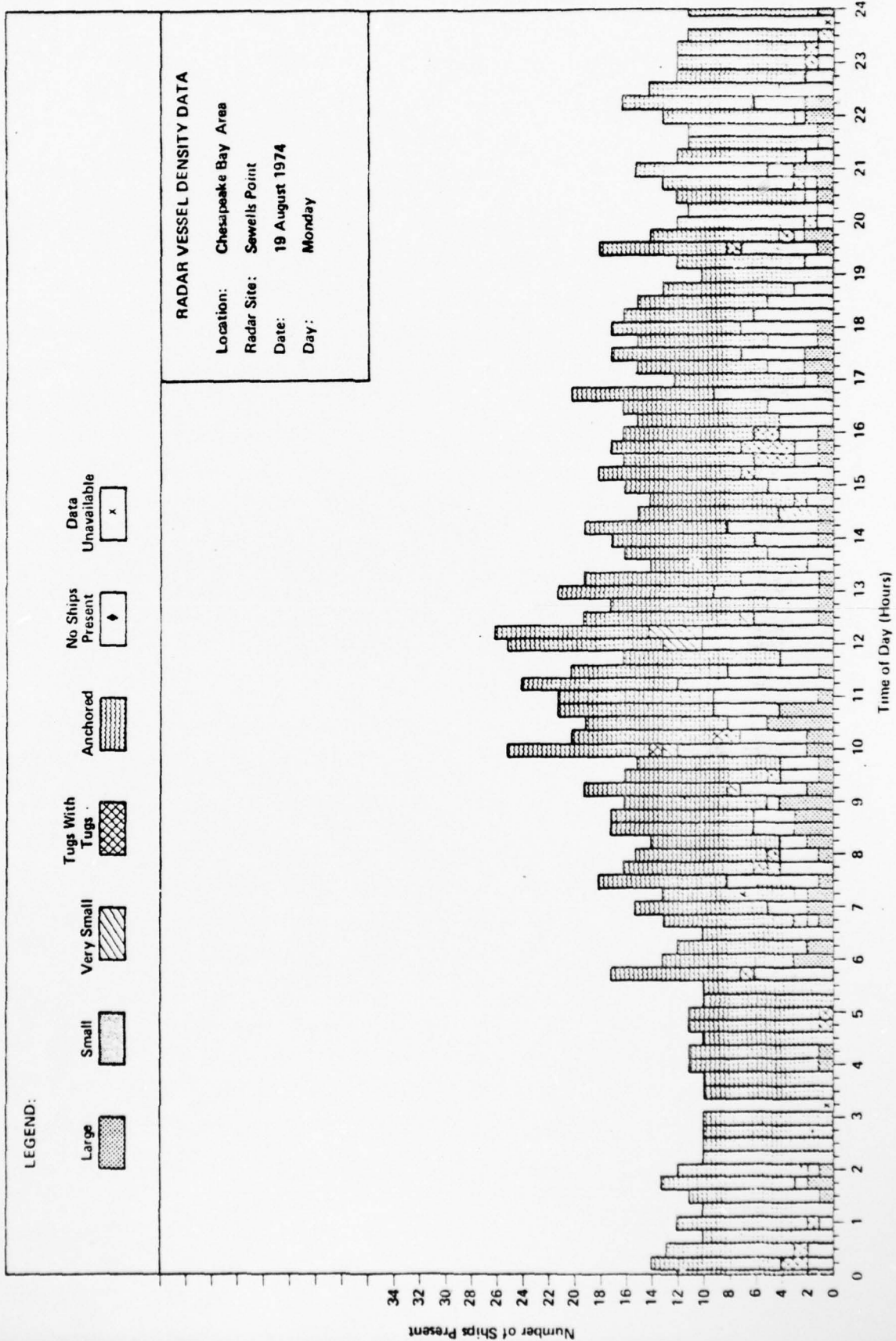
Date: 16 August 1974

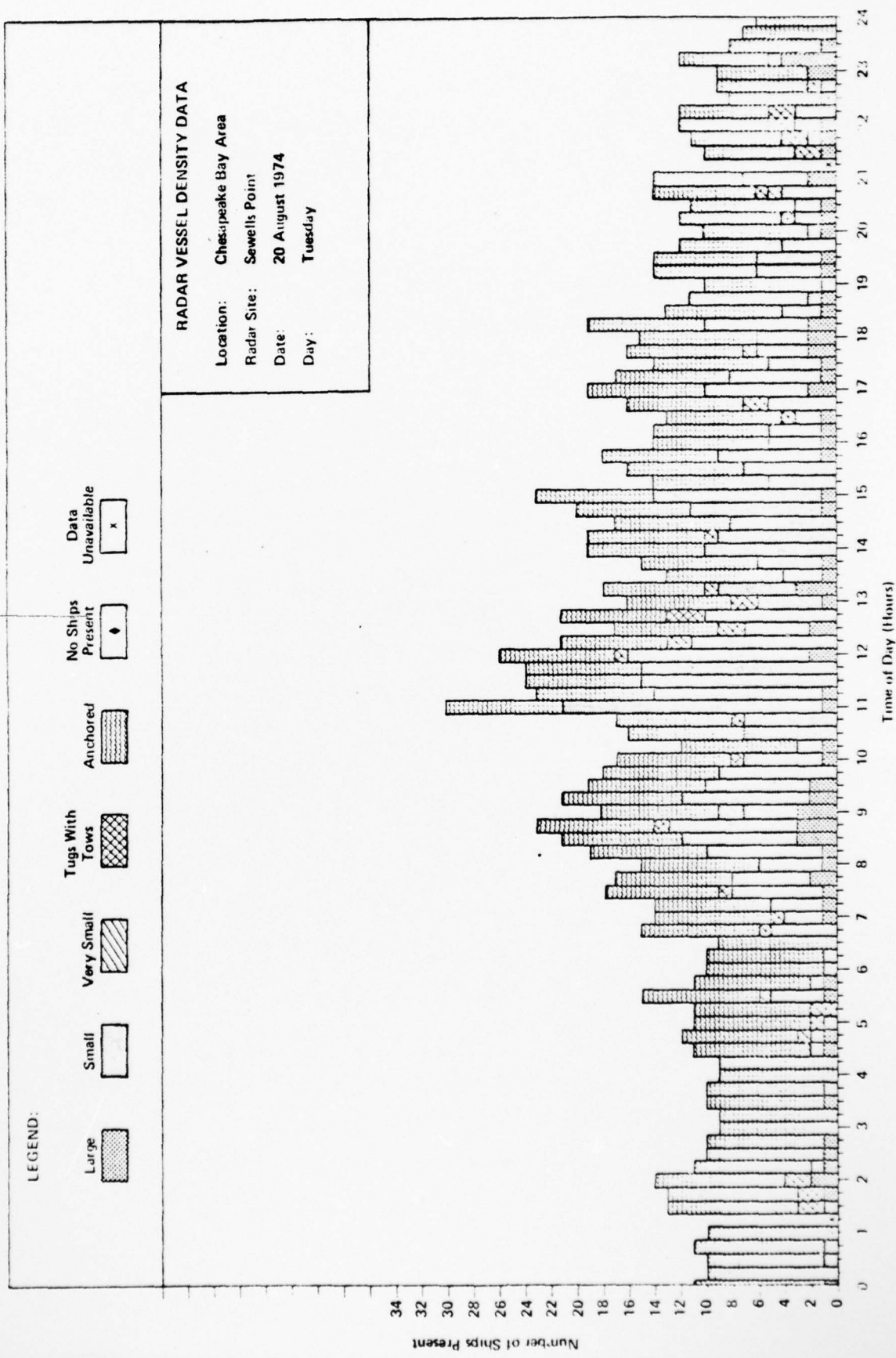
Day: Friday

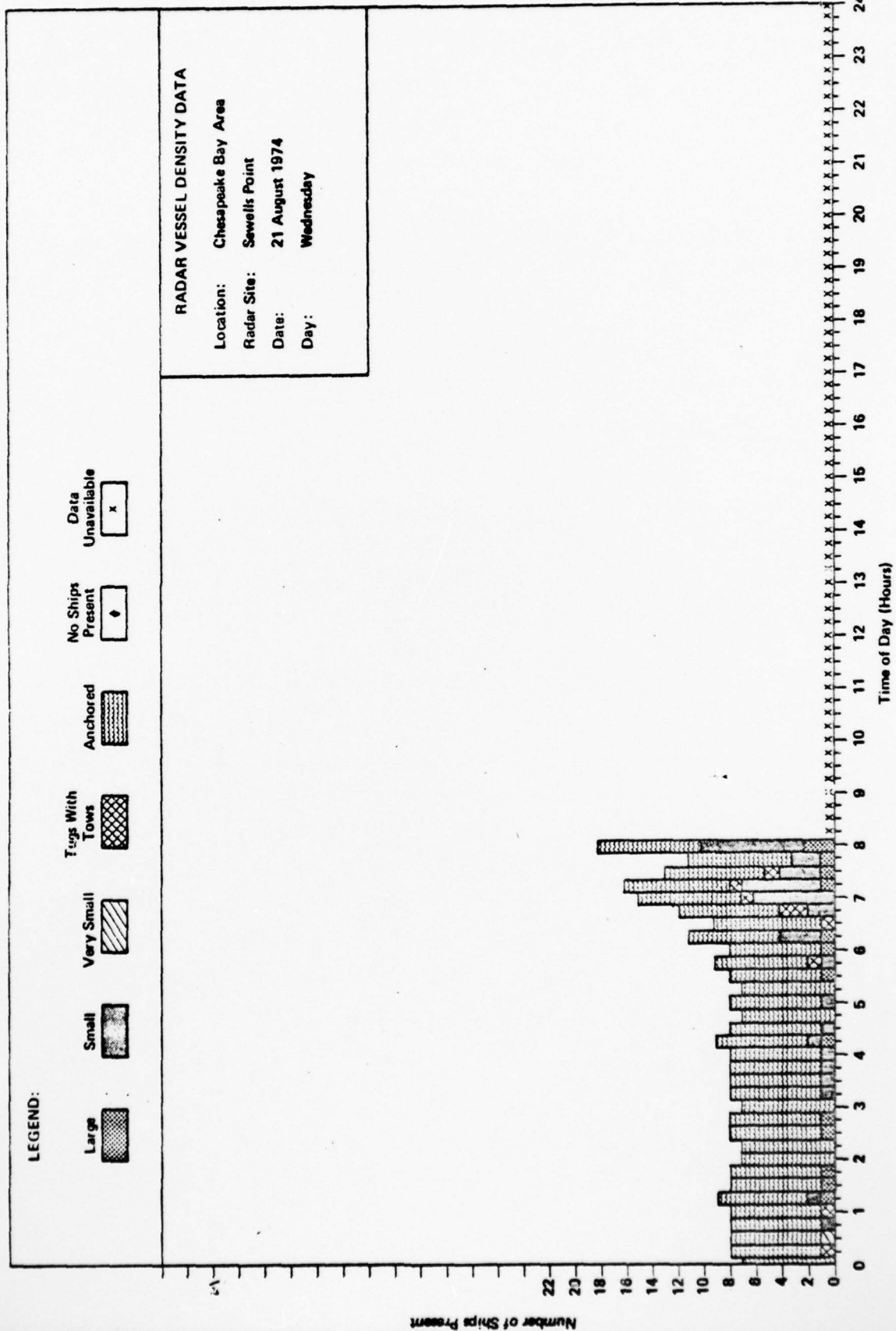












RADAR VESSEL SPEED DATA

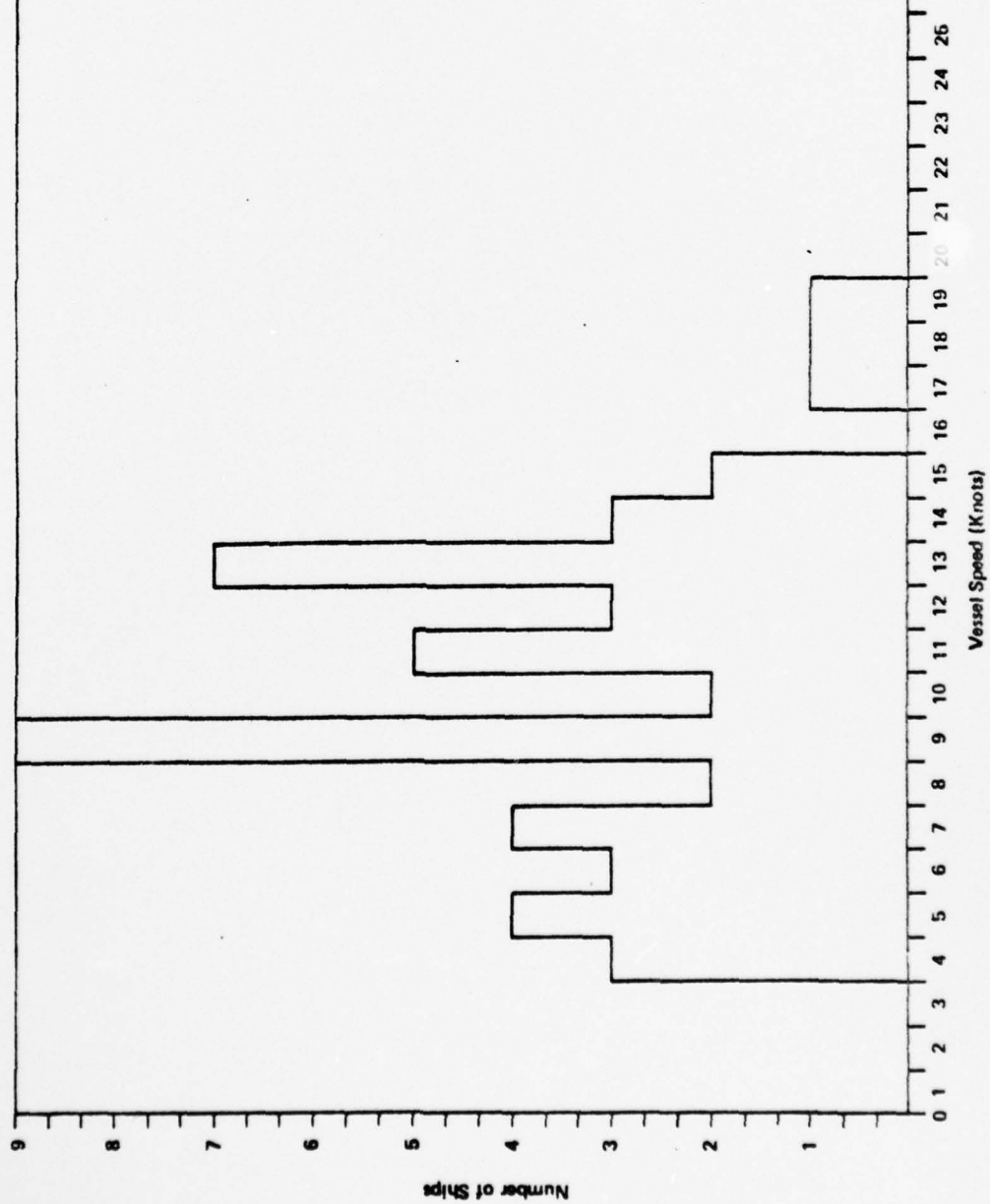
Location: Chesapeake Bay Area

Sample Size: 50

Radar Site: Sewells Point

Date: 18, 19 August 1974

Day: Sunday, Monday



SPEED DATA
FOR
SEWELLS POINT

Vessel No.	Vessel Size	Average Speed in Knots	Location*	Direction	Day	Time Hour/Minute	
1	small	18	A	North	18 August 1974 Sunday	16	41
2	small	19	A	South		16	56
3	small	12	A	North		17	11
4	small	11	A	North		17	13
5	small	13	A	South		17	26
6	large	9	B	South		17	31
7	large	4	A	South		17	56
8	small	11	A	North		18	19
9	small	14	A	North		18	29
10	small	6	A	South		18	32
11	large	7	A	North		18	37
12	large	11	A	North		19	06
13	large	7	A	North		19	19
14	small	9	A	South		20	04
15	tug with tow	4	A	North		20	04
16	tug with tow	5	A	North		20	41
17	large	12	A	South		21	57
18	small	9	A	North		22	16
19	small	11	A	North		22	22
20	small	11	A	South		22	39
21	small	13	A	South		22	48
22	large	12	A	South		23	01
23	small	10	C	SW		23	27
24	tug with tow	4	A	North		23	28
25	tug with tow	5	A	South		23	44

*A = Between Norfolk Harbor Reach and Entrance Reach
 B = Between Newport News Channel and Norfolk Harbor Reach
 C = Between Newport News Channel and Entrance Reach

SPEED DATA
FOR
SEWELLS POINT (Cont)

Vessel No.	Vessel Size	Average Speed in Knots	Location*	Direction	Day	Time Hour/Minute	
26	small	13	A	South	19 August 1974 Monday	01	06
27	large	17	C	SW		01	23
28	small	15	A	North		01	39
29	small	9	A	South		01	39
30	large	5	A	South		01	42
31	large	15	A	South		03	58
32	large	13	A	South		04	13
33	tug with tow	9	C	SW		04	50
34	tug with tow	6	C	SW		05	50
35	large	14	A	South		05	55
36	large	8	A	South		05	59
37	large	6	C	SW		06	48
38	large	7	A	South		07	05
39	small	13	A	North		07	29
40	large	9	C	SW		07	39
41	large	7	A	North		07	48
42	small	13	A	South		08	06
43	large	9	A	North		08	37
44	large	10	A	North		08	47
45	large	9	A	North		09	02
46	large	9	A	North		09	14
47	large	13	B	SW		09	48
48	large	14	A	North		09	51
49	tug with tow	5	A	South		10	20
50	large	8	A	North		10	21

*A = Between Norfolk Harbor Reach and Entrance Reach

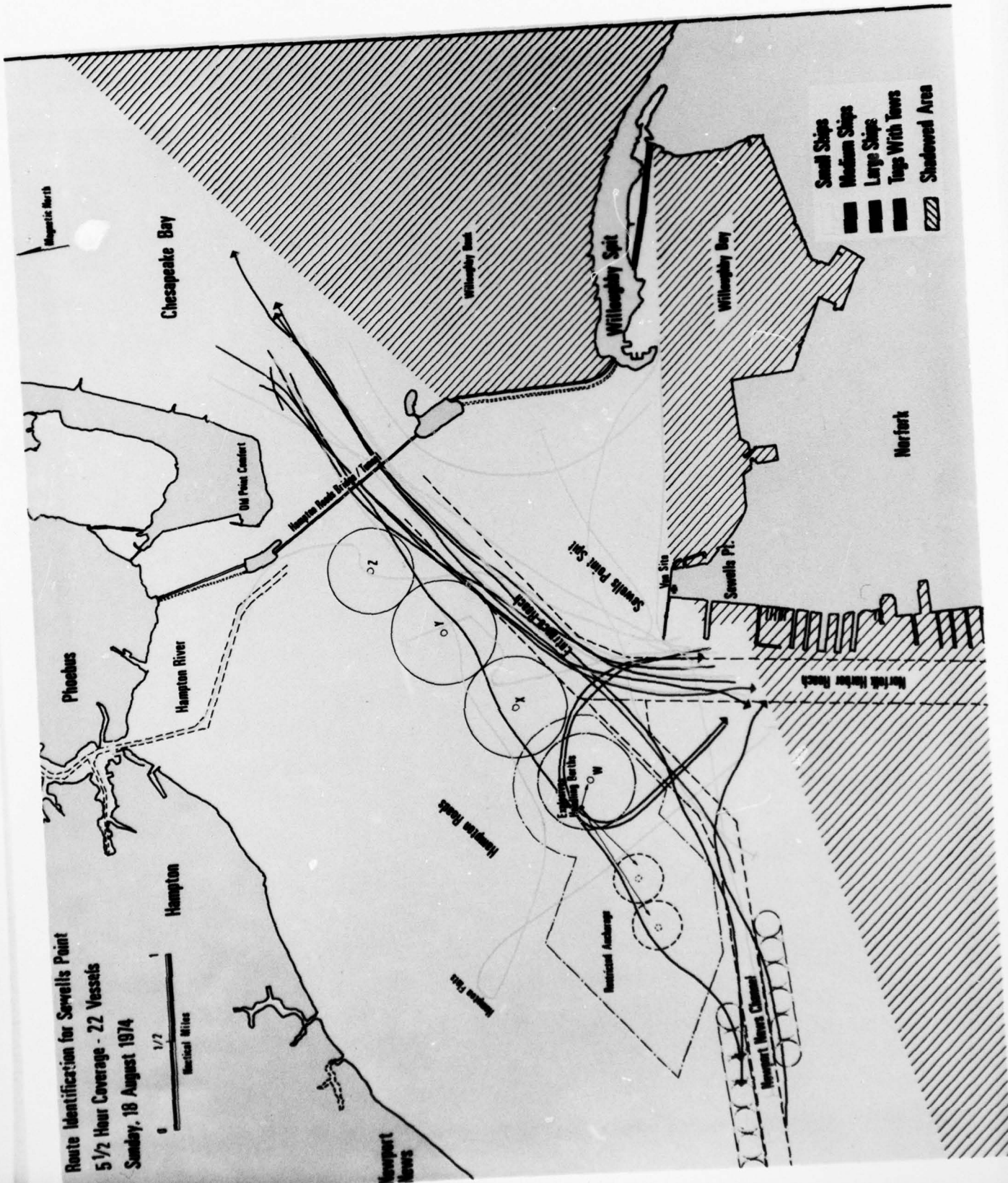
B = Between Newport News Channel and Norfolk Harbor Reach

C = Between Newport News Channel and Entrance Reach

Route Identification for Sewells Point

5 1/2 Hour Coverage - 22 Vessels

Sunday, 18 August 1974



CLOSE ENCOUNTER DATA
FOR
SEWELLS POINT

No.	Day	Time Hour/Minute		Distance Yards	Size	Manner of Approach*
1	Sunday 18 August 1974	16	18	200	1 tug, 1 large	P
2		16	21	100	2 small	P
3		16	26	100	2 small	P
4		16	30	75	2 small	C
5		16	31	<25	2 small	P
6		16	39	150	2 small	P
7		16	46	175	2 small	O
8		16	48	<25	2 small	P
9		16	50	175	2 small	C
10		16	53	100	2 small	P
11		16	57	25	2 small	C
12		16	58	200	2 small	P
13		17	03	100	2 small	P
14		17	10	100	2 small	P
15		17	12	<25	2 small	P
16		17	15	<25	2 small	P
17		17	15	200	2 small	P
18		17	21	<25	2 small	P
19		17	24	50	2 small	P
20		17	24	<25	2 small	C
21		17	32	<25	2 small	P
22		17	34	200	1 large 1 small	C
23		17	35	50	2 small	P
24		17	46	100	2 small	P
25		17	48	<25	2 small	O
26		17	56	150	2 small	P
27		18	00	200	1 large, 1 small	P
28		18	02	<25	2 small	O

*P = Passing
O = Overtaking
C = Crossing

< = less than

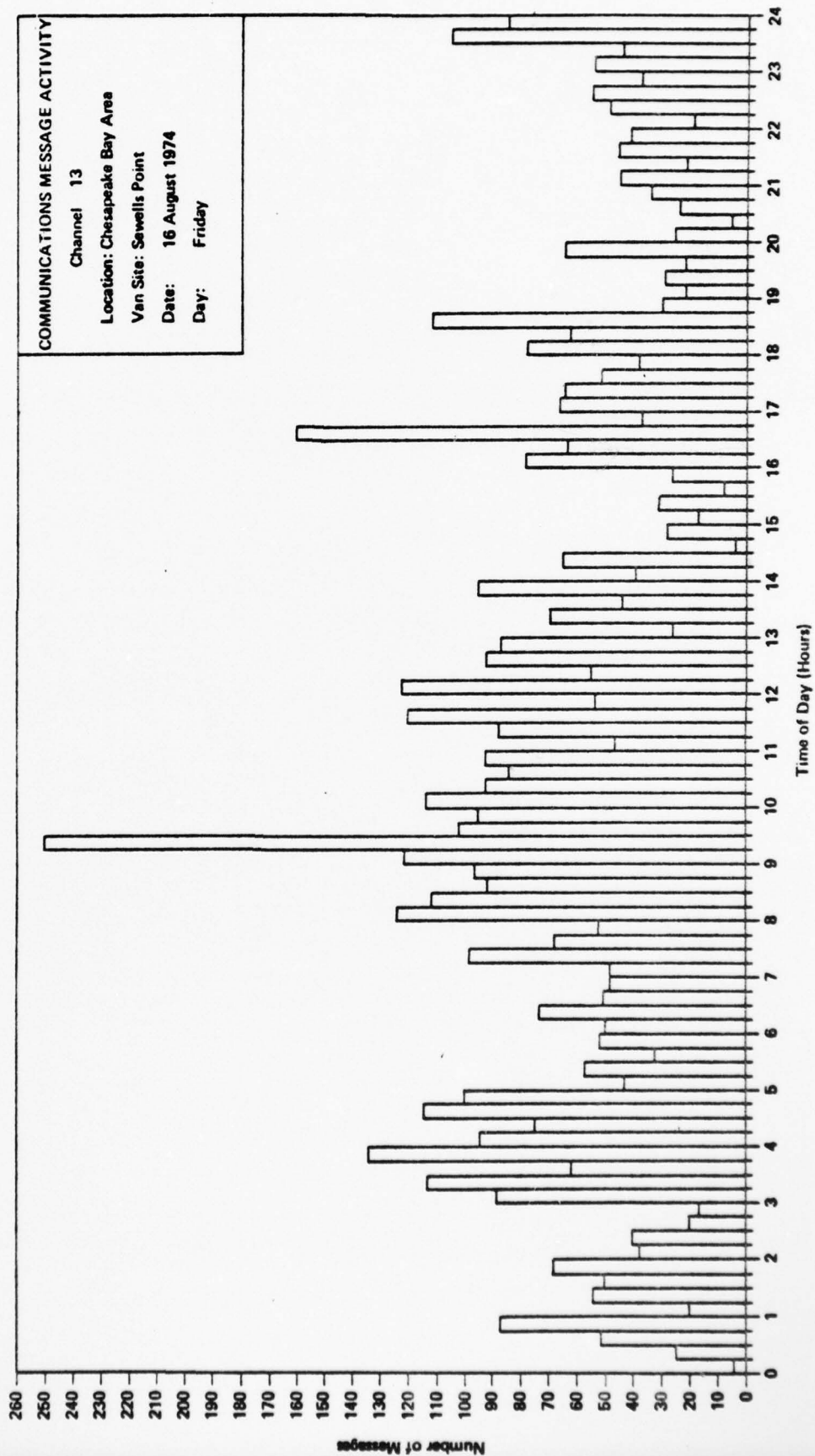
CLOSE ENCOUNTER DATA
FOR
SEWELLS POINT (CONT)

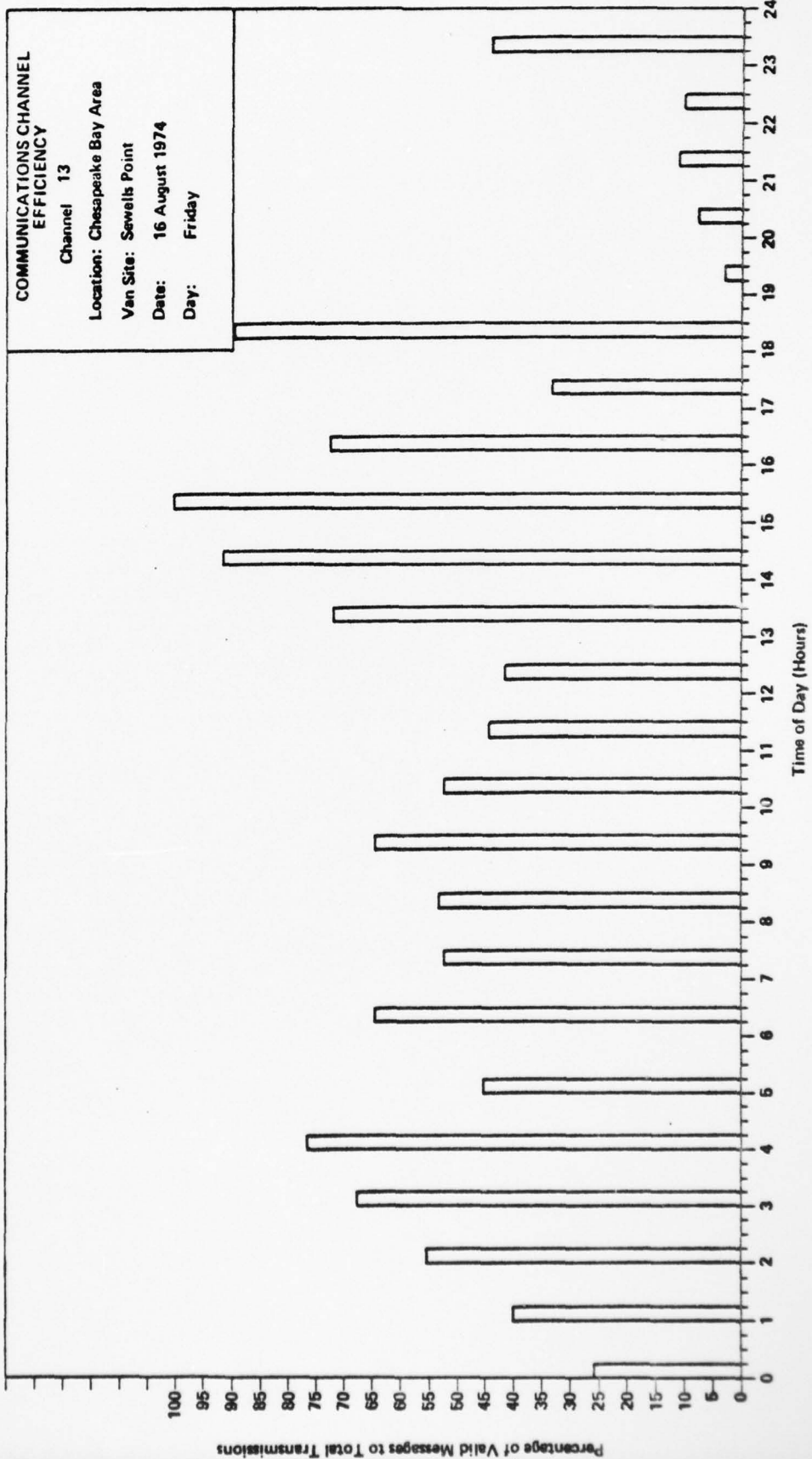
No.	Day	Time Hour/Minute		Distance Yards	Size	Manner of Approach*
29	' Sunday 18 August 1974	18	04	<25	2 small	P
30		18	04	<25	2 small	P
31		18	06	<25	1 medium, 1 small	O
32		18	06	<25	2 small	O
33		18	07	<25	2 small	O
34		18	08	<25	2 small	P
35		18	08	<25	2 small	P
36		18	08	<25	2 small	O
37		18	10	150	1 large, 1 small	O
38		18	13	175	2 small	P
39		18	13	<25	2 small	P
40		18	15	<25	2 small	P
41		18	16	<25	2 small	P
42		18	21	<25	2 small	P
43		18	21	<25	2 small	P
44		18	24	125	2 small	P
45		18	26	50	2 small	P
46		18	28	100	2 small	C
47		18	32	100	2 small	P
48		18	37	150	2 small	C
49		18	38	200	2 small	C
50		18	39	100	2 small	P

50 close encounters out of 161 encounters during a
2-hour and 25-minute period

*P = Passing
O = Overtaking
C = Crossing

< = less than





AD-A038 432

OPERATIONS RESEARCH INC SILVER SPRING MD
VESSEL TRAFFIC DATA FOR CHESAPEAKE BAY AREA.(U)
NOV 75 L BUHLER, J STALEY, T NIGHTENGALE
ORI-TR-969

F/G 15/5

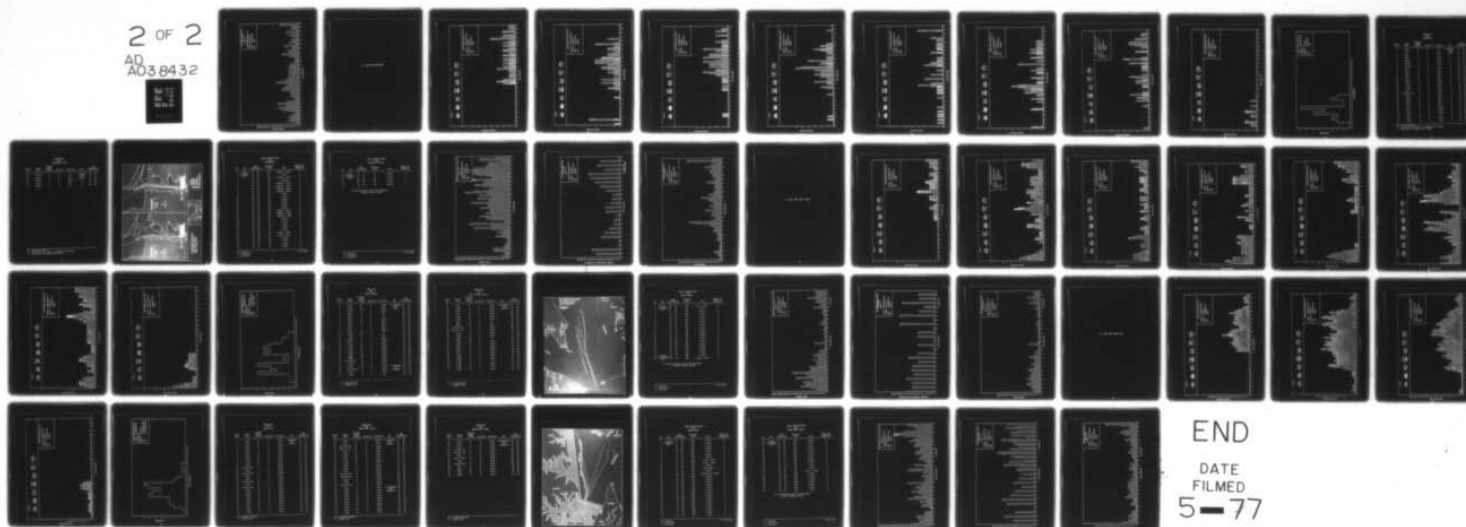
UNCLASSIFIED

DOT-CG-31446-A

NL

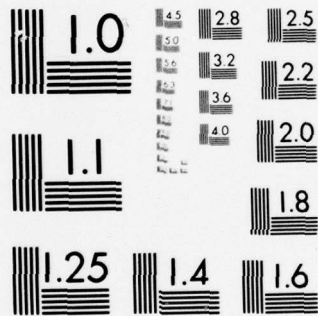
2 OF 2

AD
A038432

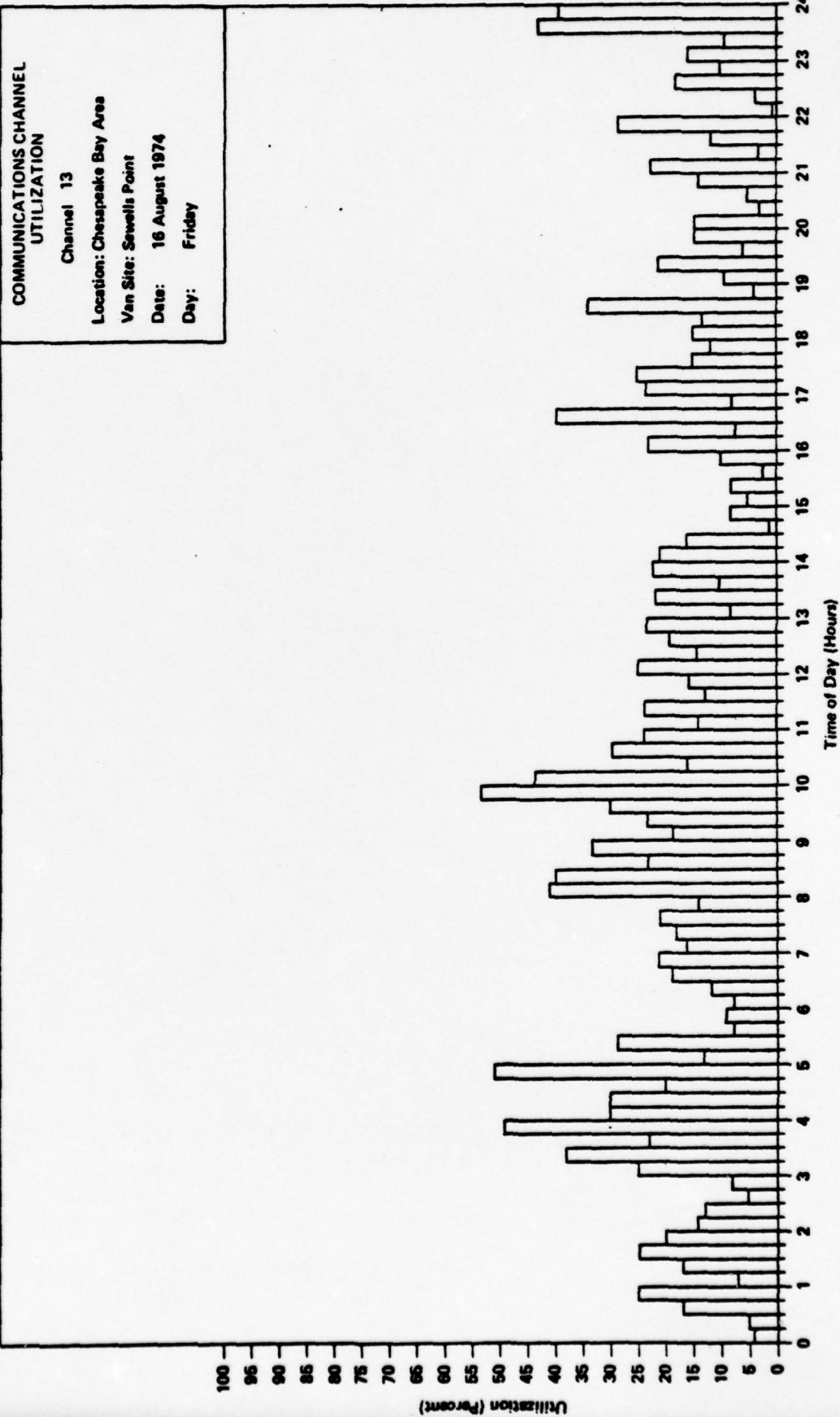


END

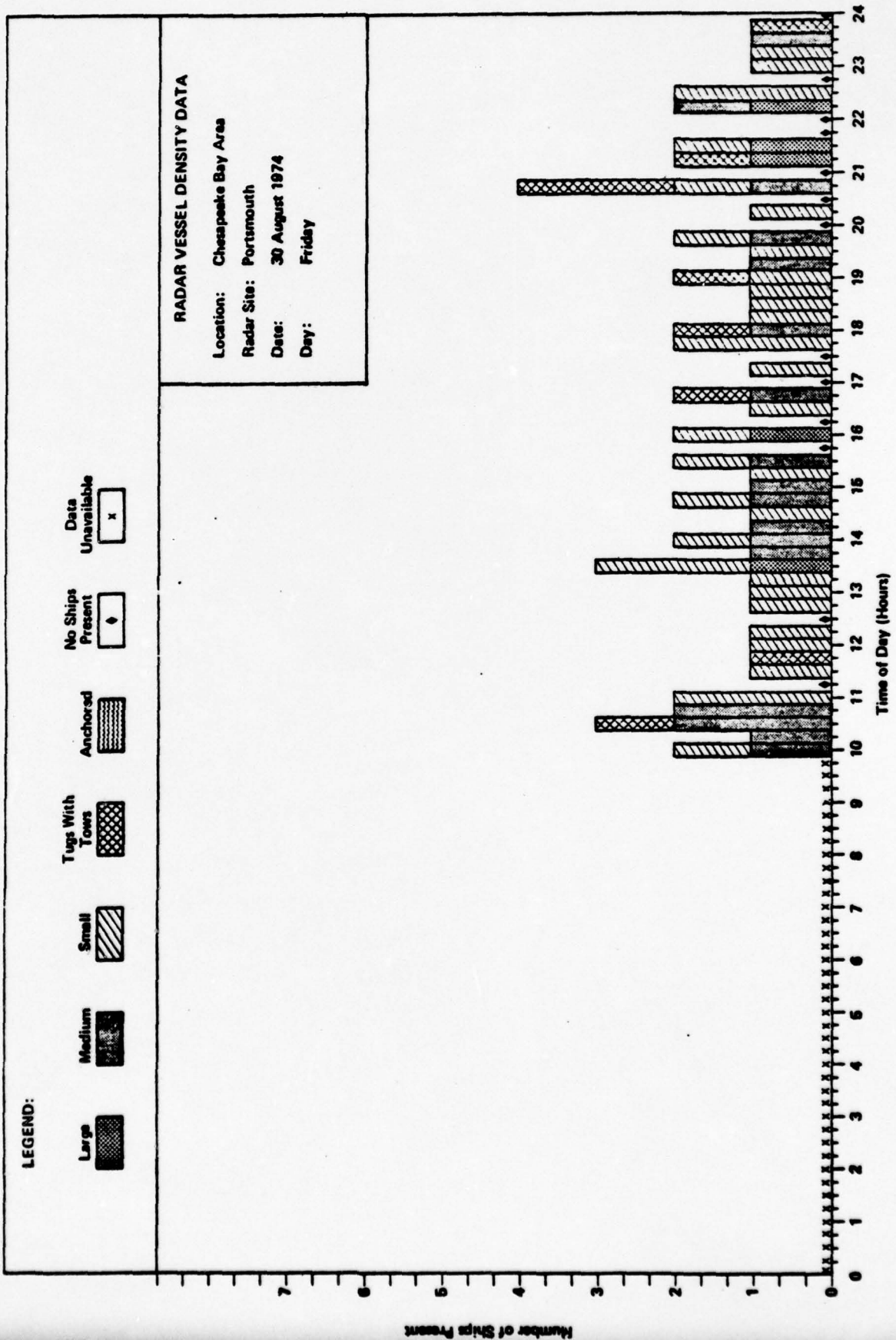
DATE
FILMED
5-77

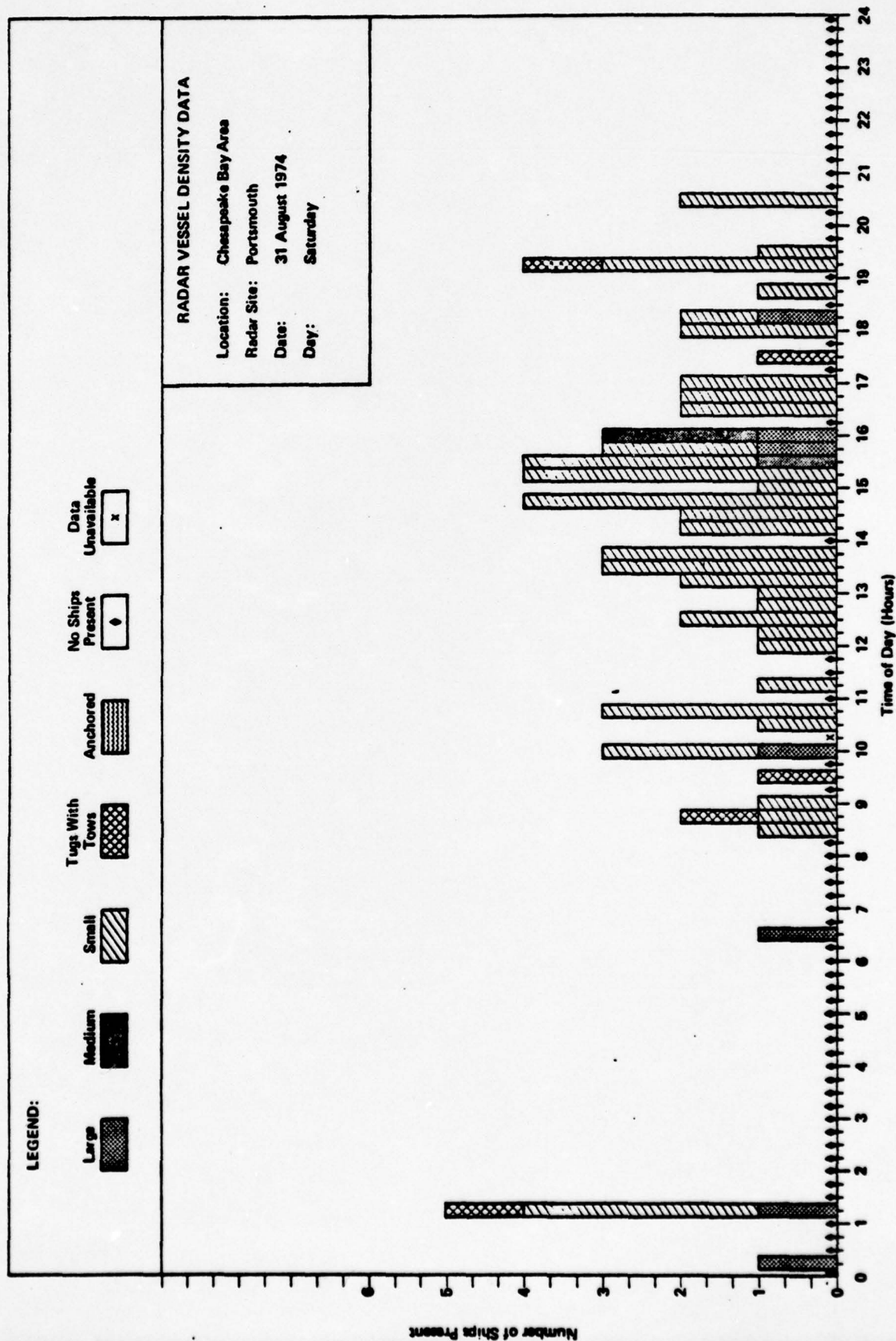


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



2.4 DATA FROM PORTSMOUTH



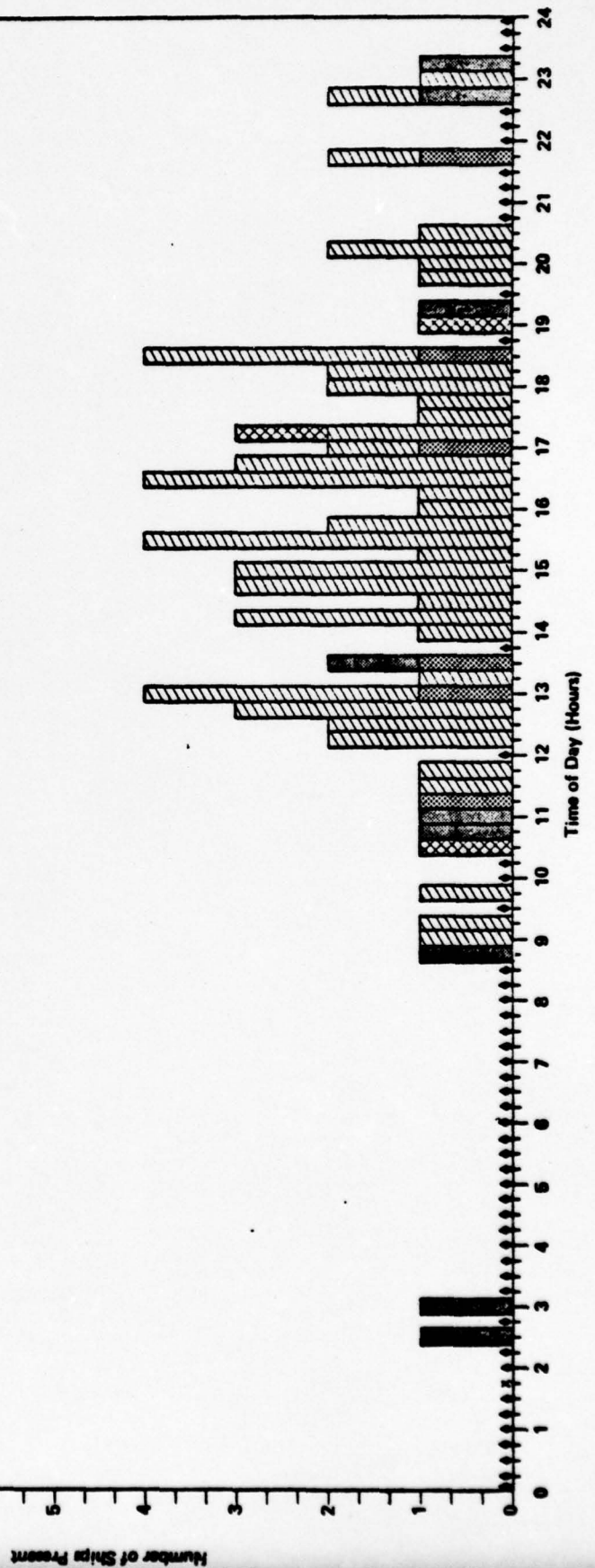


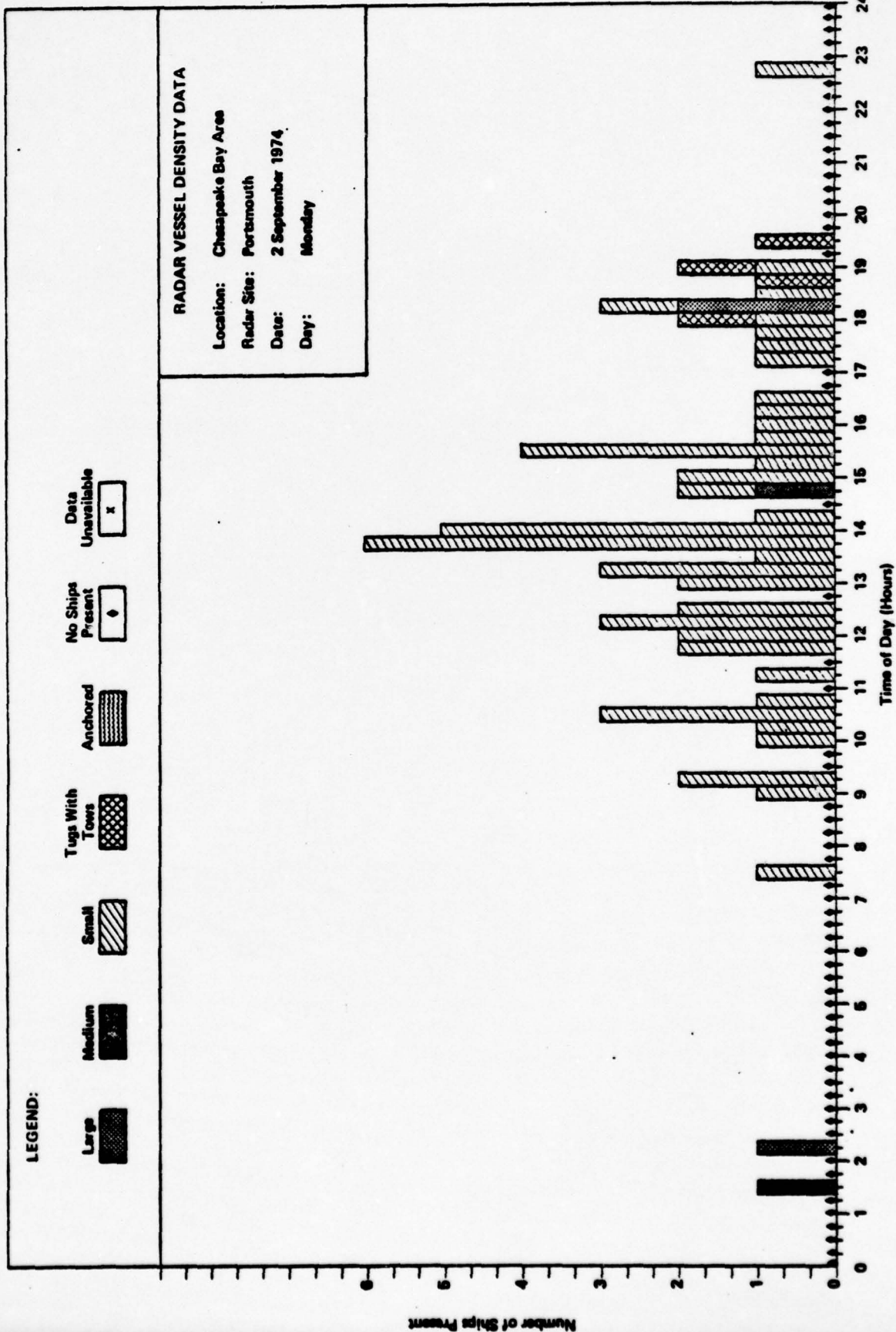
LEGEND:

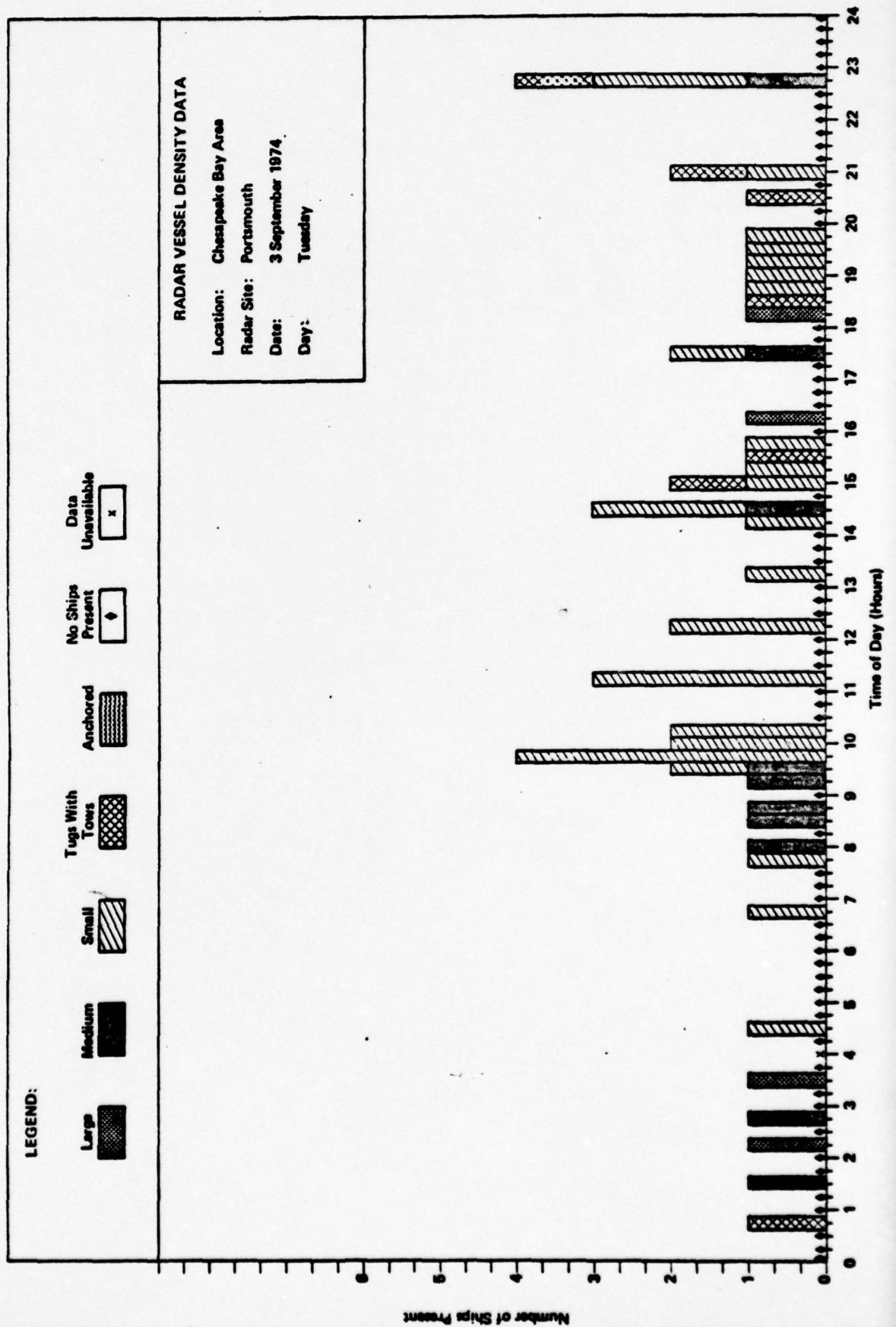


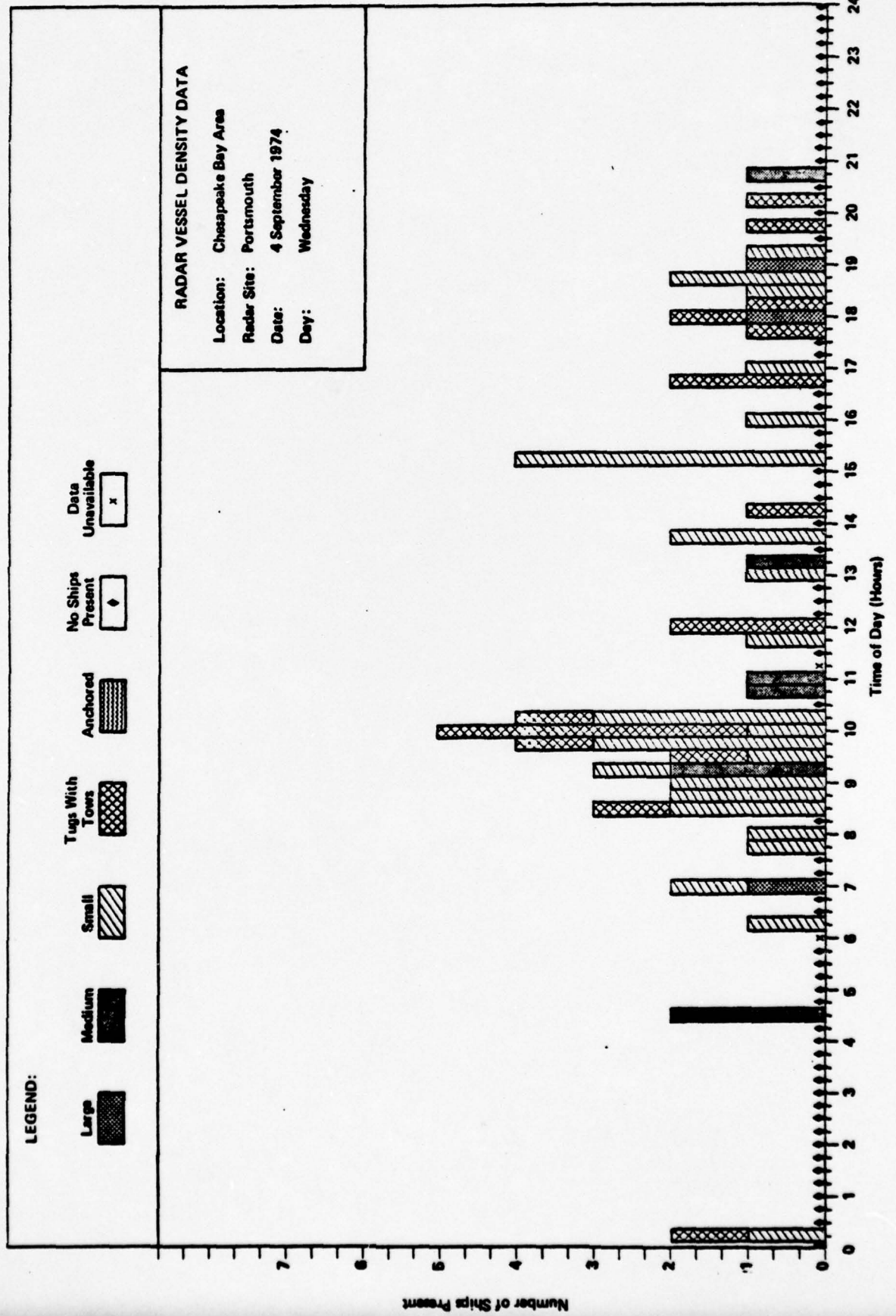
RADAR VESSEL DENSITY DATA

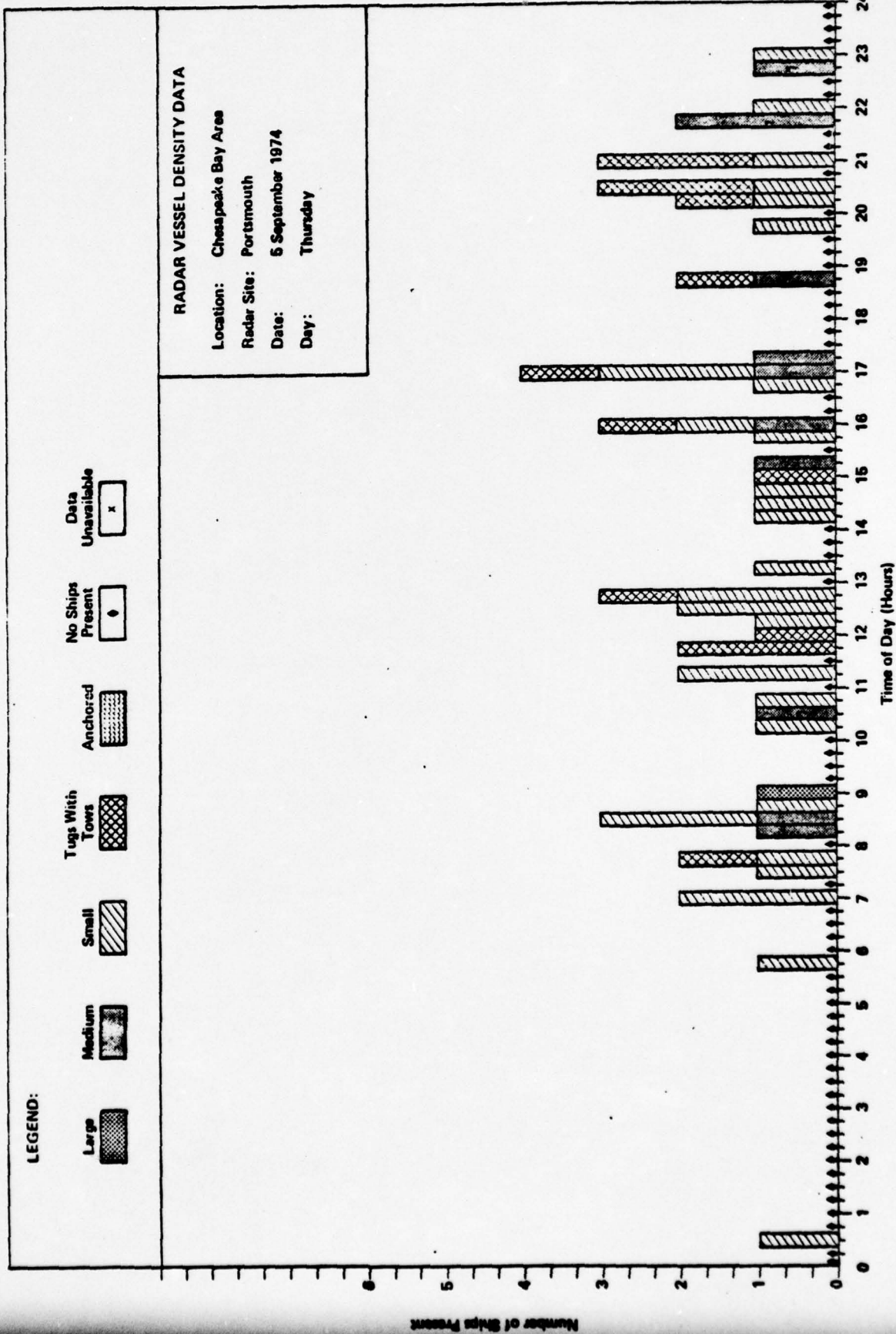
Location: Chesapeake Bay Area
 Radar Site: Portsmouth
 Date: 1 September 1974
 Day: Sunday

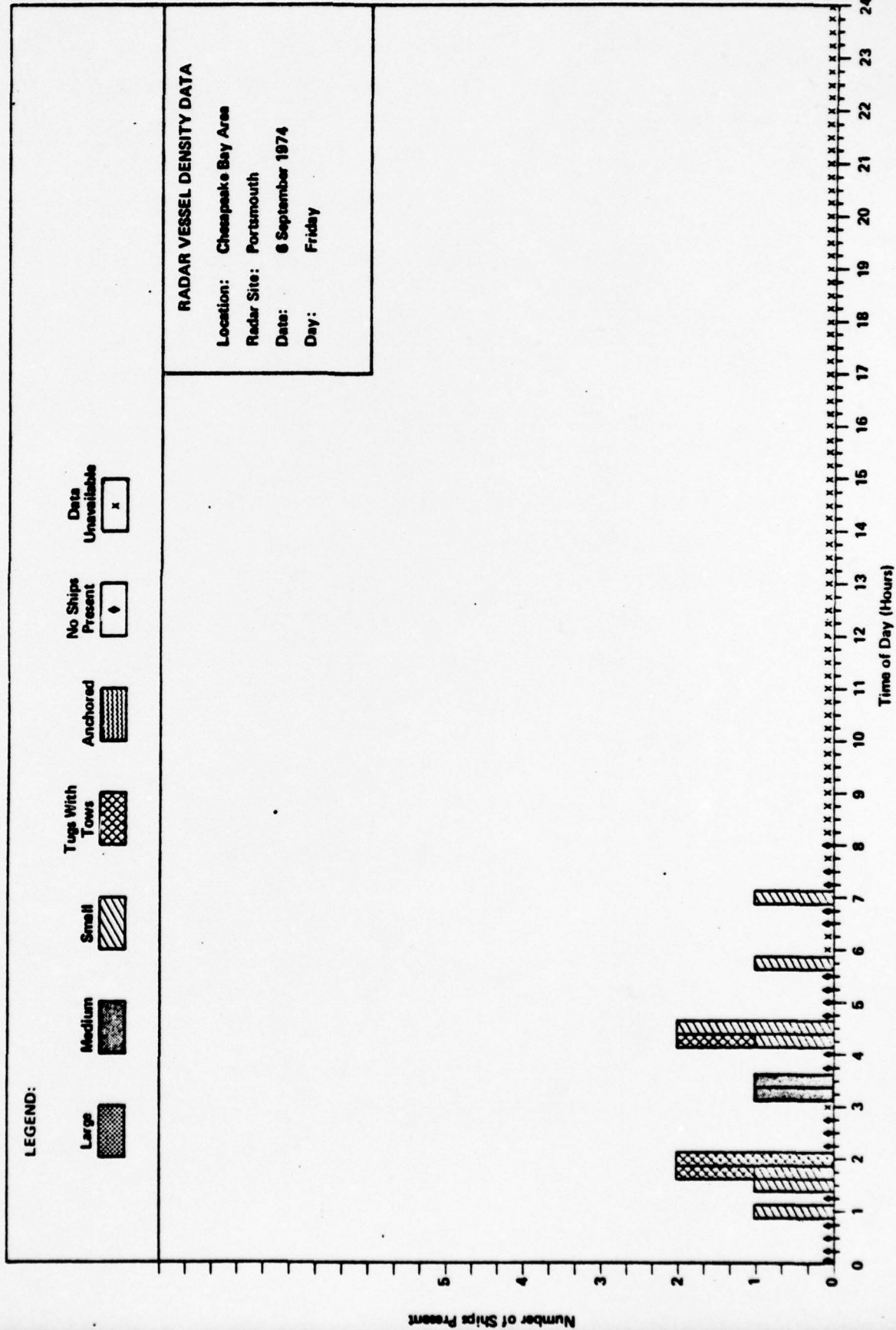


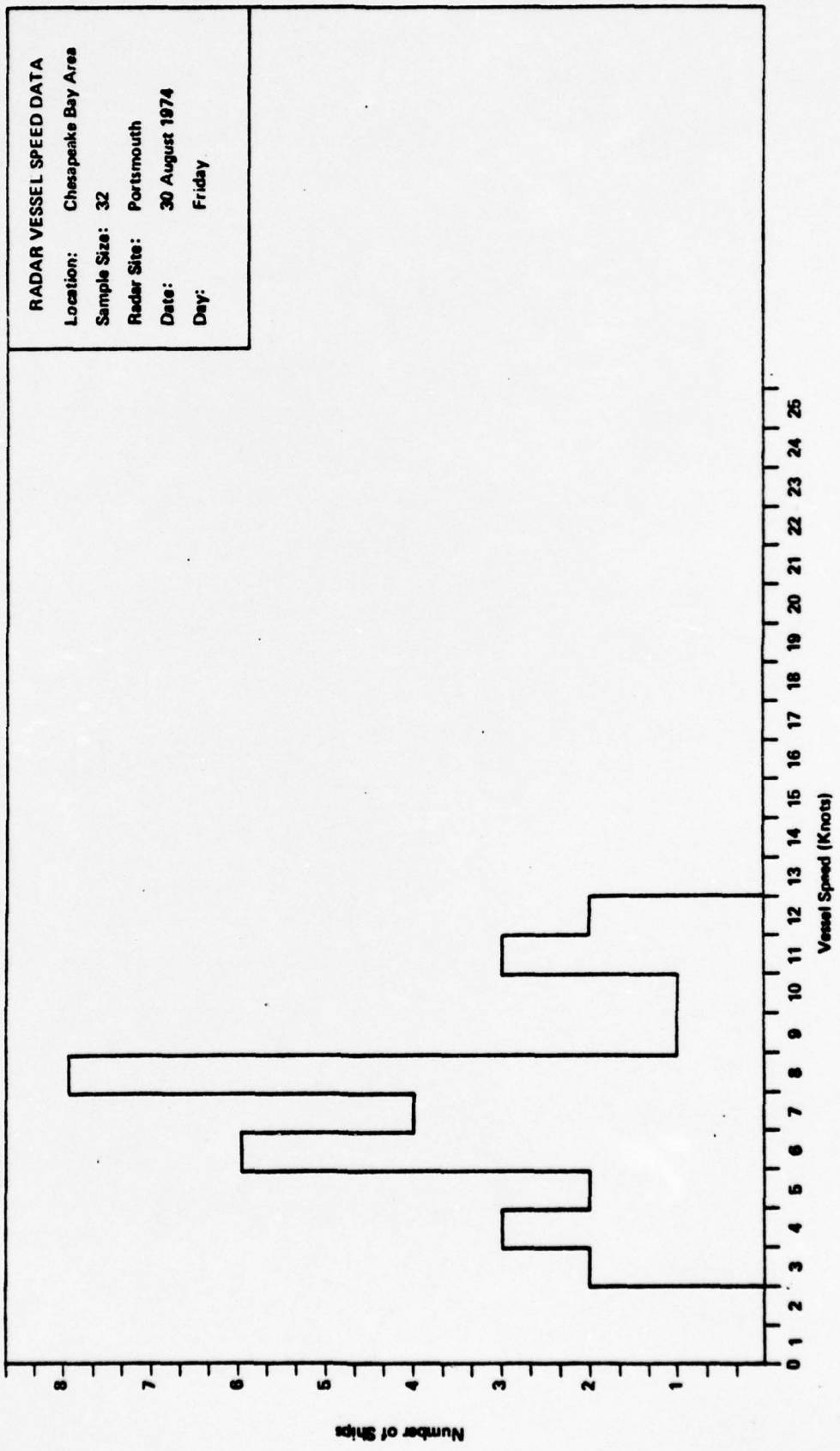












SPEED DATA
FOR
PORTSMOUTH

Vessel No.	Vessel Size	Average Speed in Knots	Location*	Direction	Day	Time Hour/Minute	
1	large	6	B	SW	30 August 1974 Friday ↓	13	31
2	small	12	C	East		14	14
3	large	7	B	SW		14	20
4	small	8	A	South		14	30
5	medium	7	A	North		14	33
6	medium	6	A	North		14	41
7	medium	8	B	NE		14	46
8	small	5	A	South		14	56
9	small	9	C	East		15	07
10	small	11	C	West		15	29
11	small	11	C	East		15	40
12	large	8	C	West		15	55
13	small	5	A	South		15	56
14	large	8	C	West		15	58
15	large	6	C	East		16	00
16	small	6	A	South		16	26
17	tug with tow	3	C	East		16	42
18	small	7	C	East		16	42
19	medium	6	C	East		16	53
20	small	11	C	West		17	36
21	small	12	C	West		17	40
22	large	4	A	South		17	49
23	small	8	A	North		17	56
24	large	5	A	North		17	59
25	small	10	B	SW		18	06
26	small	8	A	South		18	22
27	large	4	A	North		18	57

*A = Town Point Reach

B = Elizabeth River Tunnel - Elizabeth River Bridge

C = Town Point- Elizabeth River Bridge

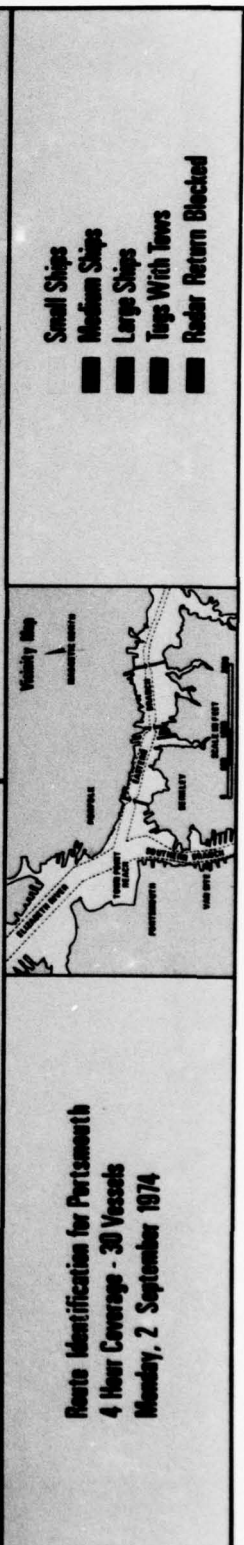
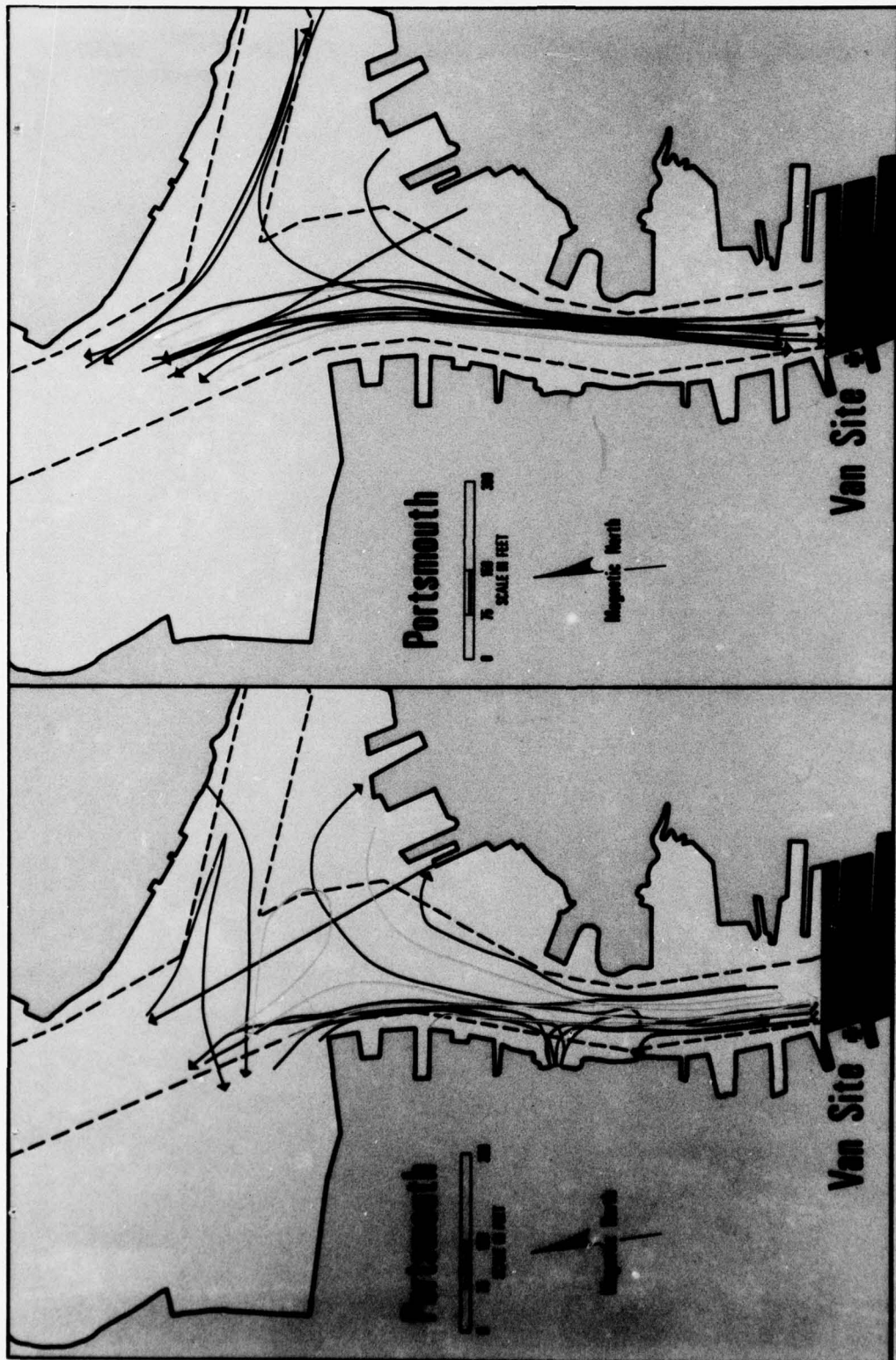
SPEED DATA
FOR
PORTSMOUTH (CONT)

Vessel No.	Vessel Size	Average Speed in Knots	Location*	Direction	Day	Time Hour/Minute	
28	medium	6	B	NE	30 August	19	01
29	medium	8	B	NE	1974	19	11
30	medium	3	A	South	Friday	19	40
31	large	4	C	East	↓	20	38
32	medium	8	B	NE	↓	20	42

*A = Town Point Reach

B = Elizabeth River Tunnel - Elizabeth River Bridge

C = Town Point- Elizabeth River Bridge



CLOSE ENCOUNTER DATA
FOR
PORTSMOUTH

No.	Day	Time Hour/Minute		Distance Yards	Size	Manner of Approach*
1	Monday 2 September 1974	14	04	<25	1 medium, 1 small	P
2		14	07	<25	2 small	O
3		14	18	40	1 medium, 1 small	P
4		14	19	80	2 medium	P
5		14	21	75	1 medium, 1 small	P
6		14	22	40	1 medium, 1 small	P
7		14	22	35	1 medium, 1 small	P
8		14	23	90	1 medium, 1 small	P
9		14	25	30	2 small	O
10		14	25	40	2 small	O
11		14	26	40	2 small	O
12		14	35	50	2 small	P
13		14	41	70	2 small	P
14		14	42	90	2 small	P
15		14	43	50	1 medium, 1 small	O
16		14	43	80	1 medium, 1 small	P
17		14	46	<40	1 medium, 1 small	P
18		14	48	50	2 small	P
19		14	49	70	2 small	P
20		15	00	40	2 small	O
21		15	21	30	2 small	O
22		15	36	25	2 small	P
23		15	42	40	1 large, 1 small	P
24		15	43	40	1 large, 1 small	P
25		15	54	50	2 small	P
26		16	07	30	2 small	C
27		16	15	50	2 small	P
28		16	15	40	2 small	P

*P = Passing
O = Overtaking
C = Crossing

< = less than

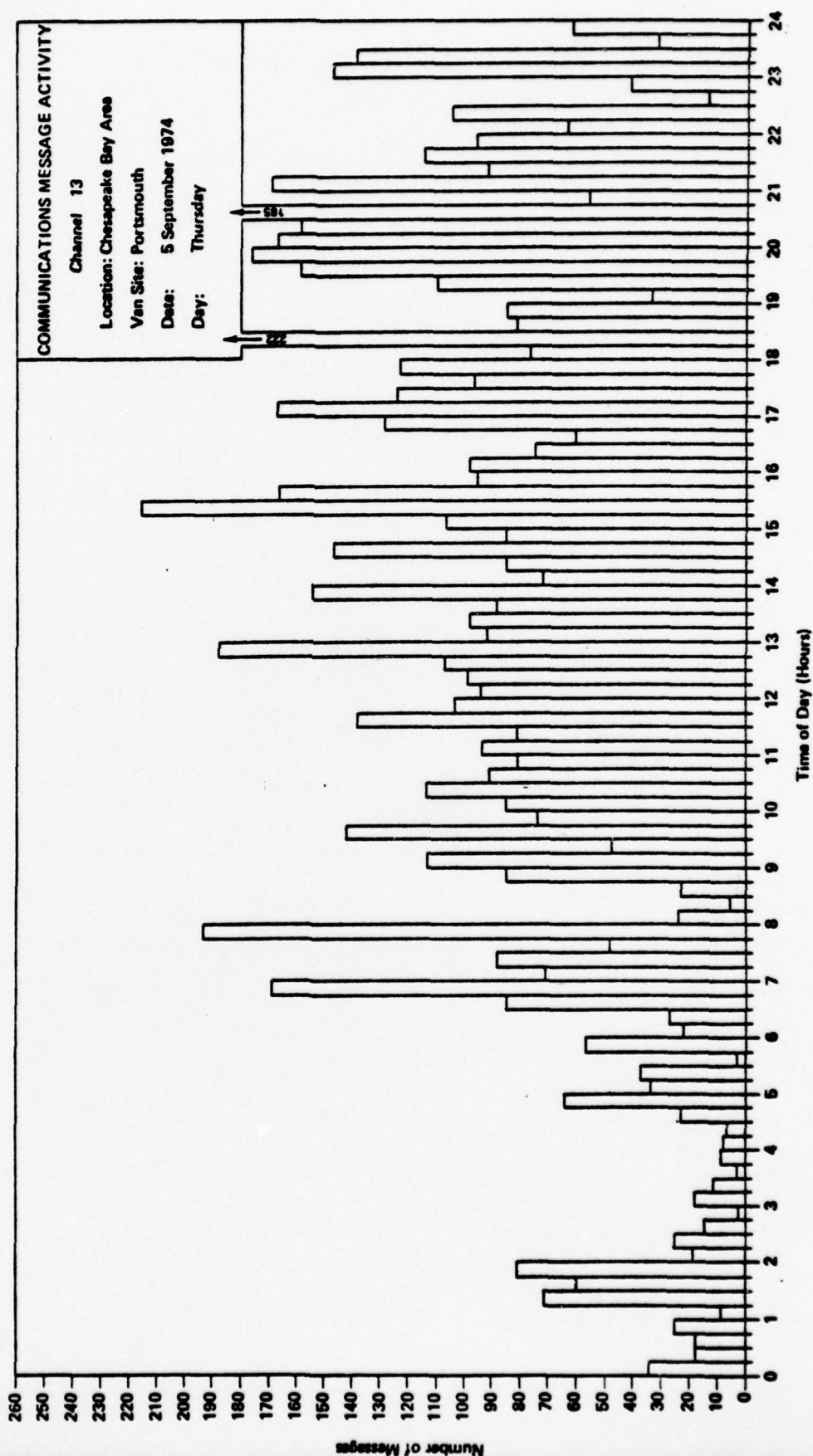
CLOSE ENCOUNTER DATA
FOR
PORTSMOUTH (CONT)

No.	Day	Time Hour/Minute		Distance Yards	Size	Manner of Approach*
29	Monday	16	17	70	2 small	P
30	2 September 1974	16	19	30	2 small	P
31		16	28	90	2 small	P
32		16	32	50	2 small	P
33		16	35	50	2 small	P

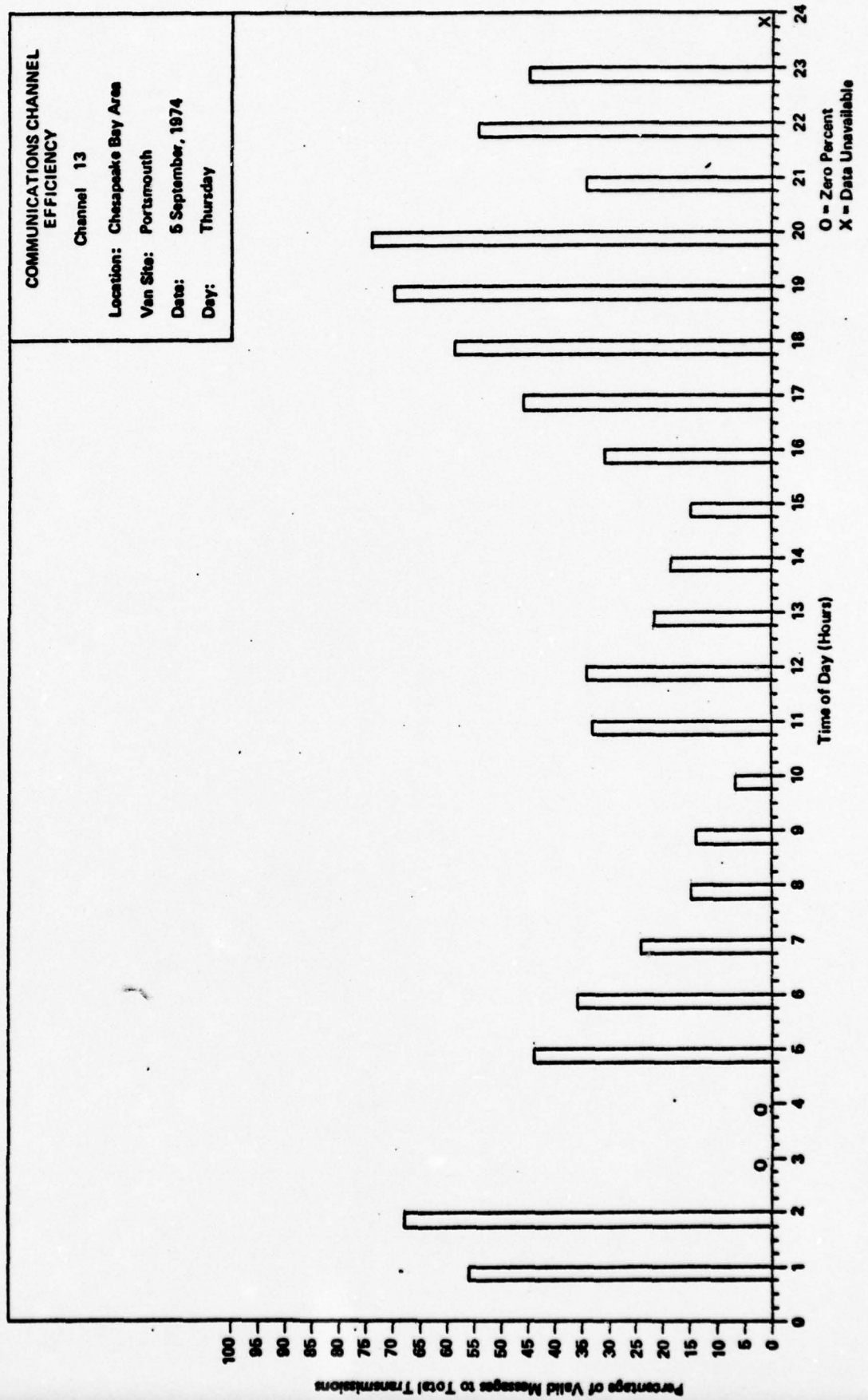
33 close encounters out of 42 encounters
during a 2½-hour period.

*P = Passing
O = Overtaking
C = Crossing

< = less than



**COMMUNICATIONS CHANNEL
EFFICIENCY**
 Channel 13
 Location: Chesapeake Bay Area
 Van Site: Portsmouth
 Date: 5 September, 1974
 Day: Thursday



COMMUNICATIONS CHANNEL
UTILIZATION

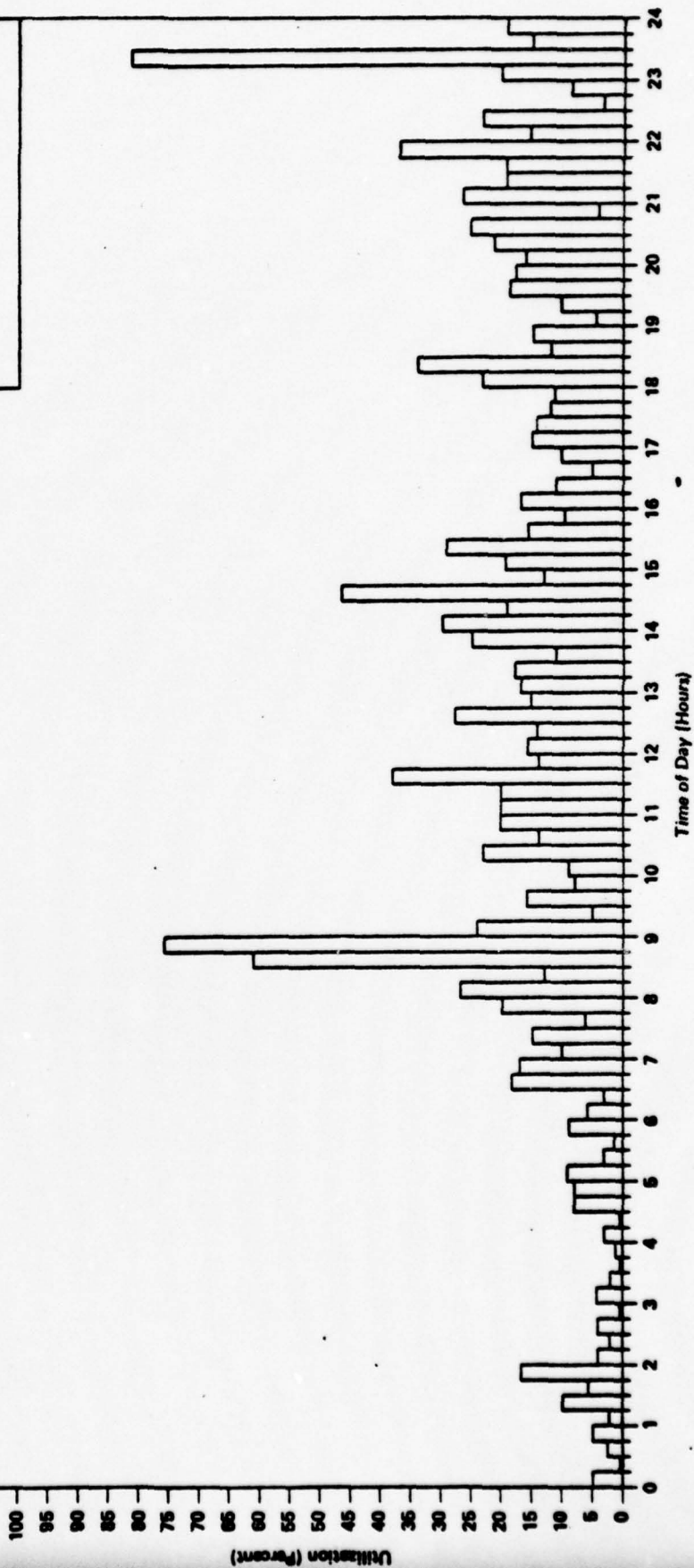
Channel 13

Location: Chesapeake Bay Area

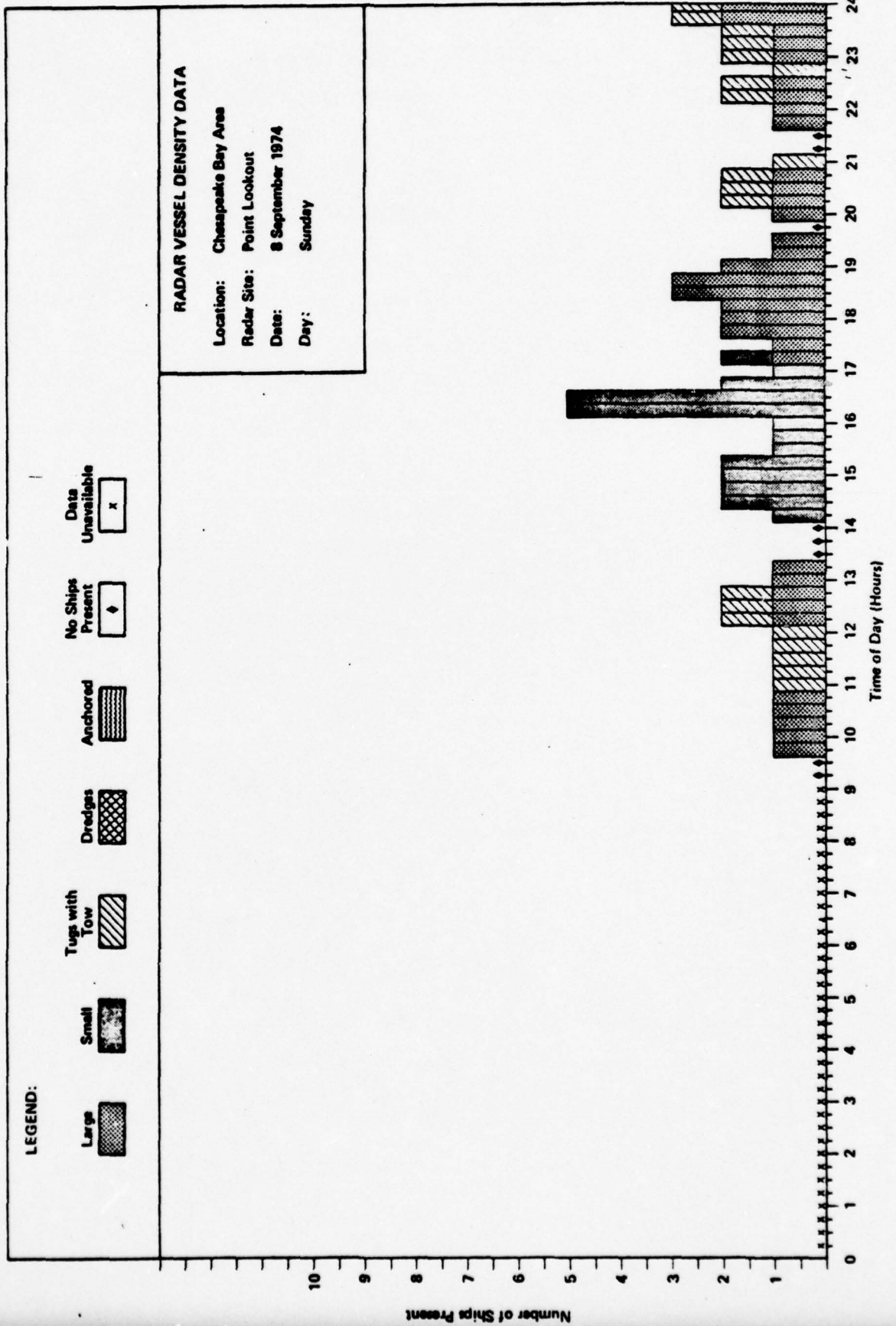
Van Site: Portsmouth

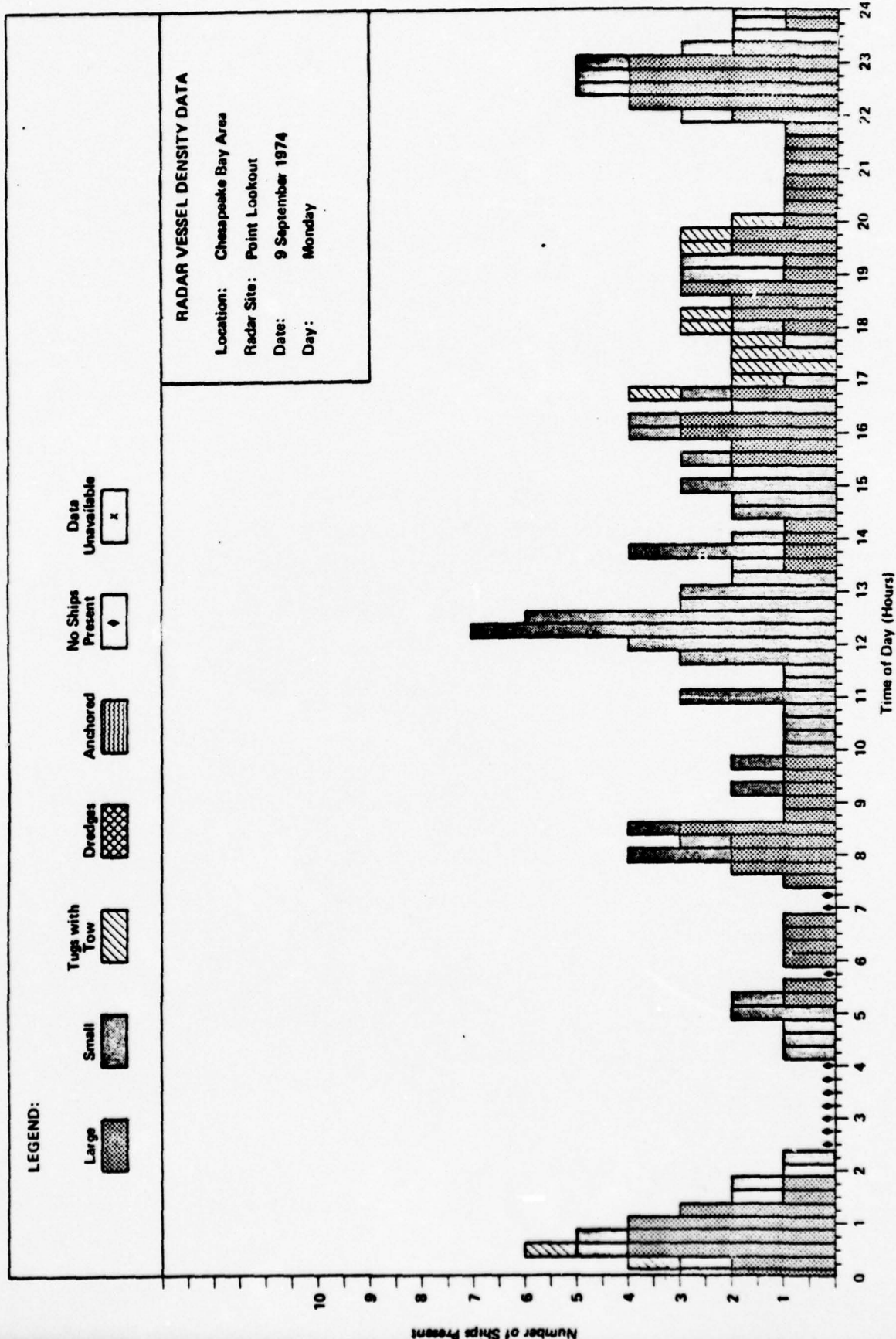
Date: 5 September 1974

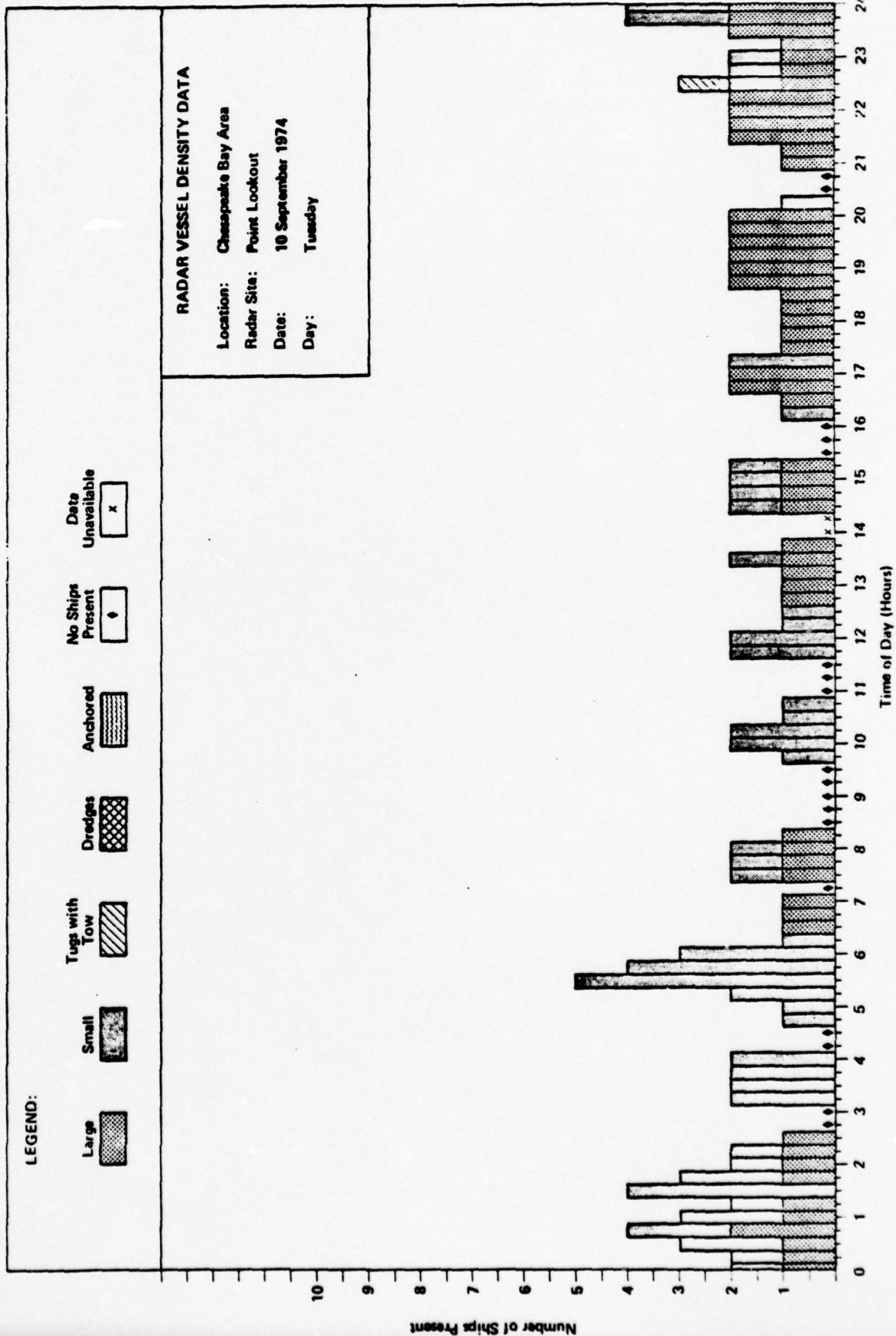
Day: Thursday



2.5 DATA FROM POINT LOOKOUT





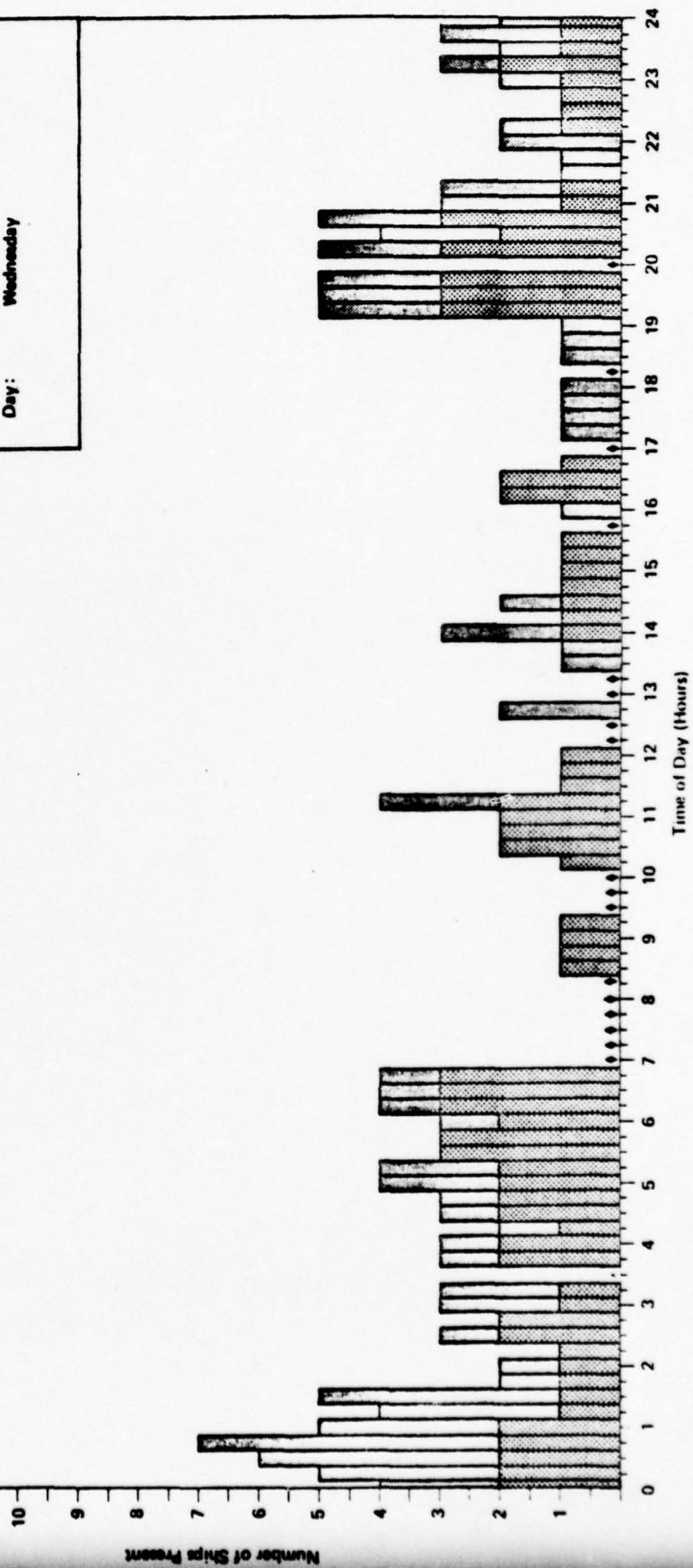


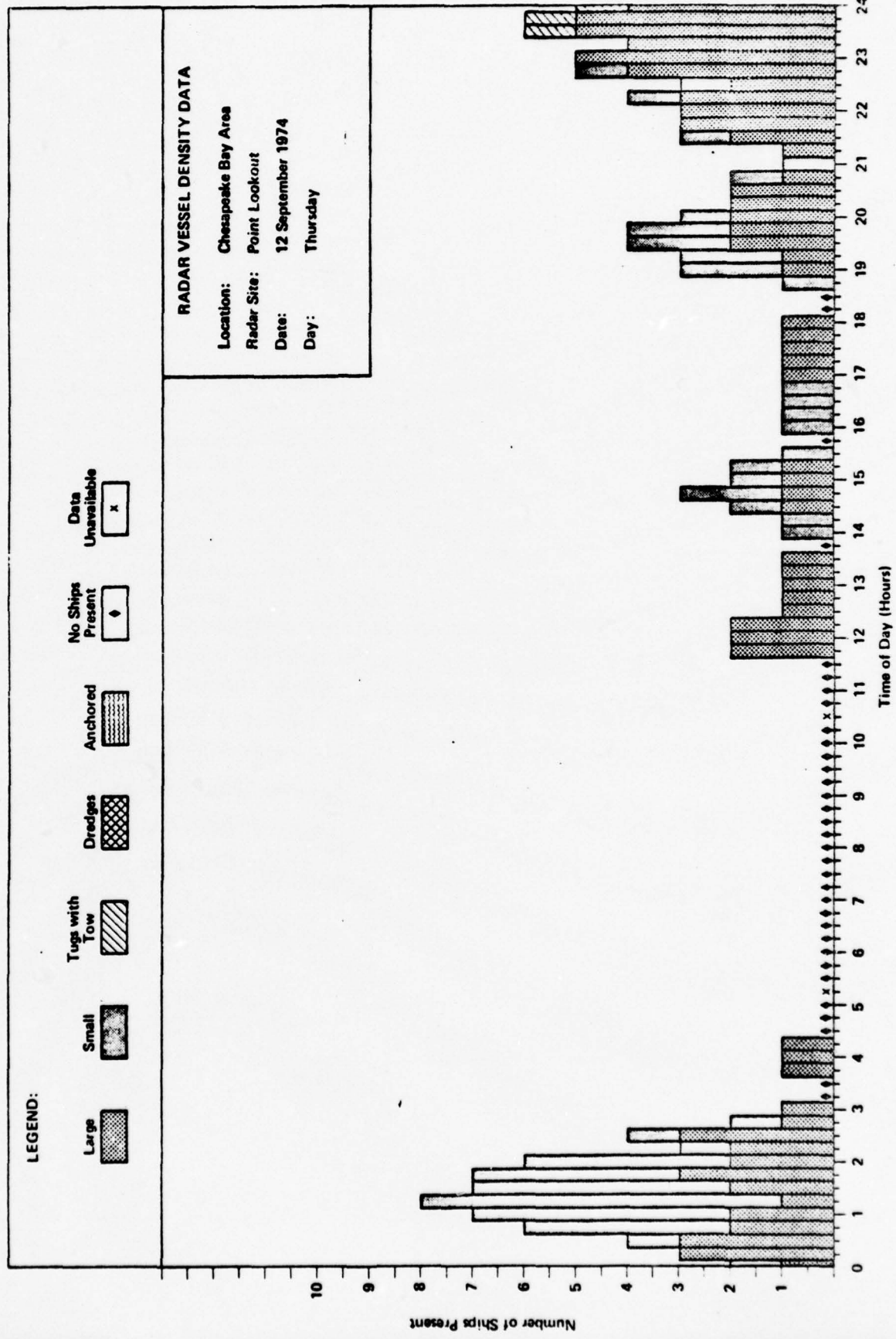
LEGEND:

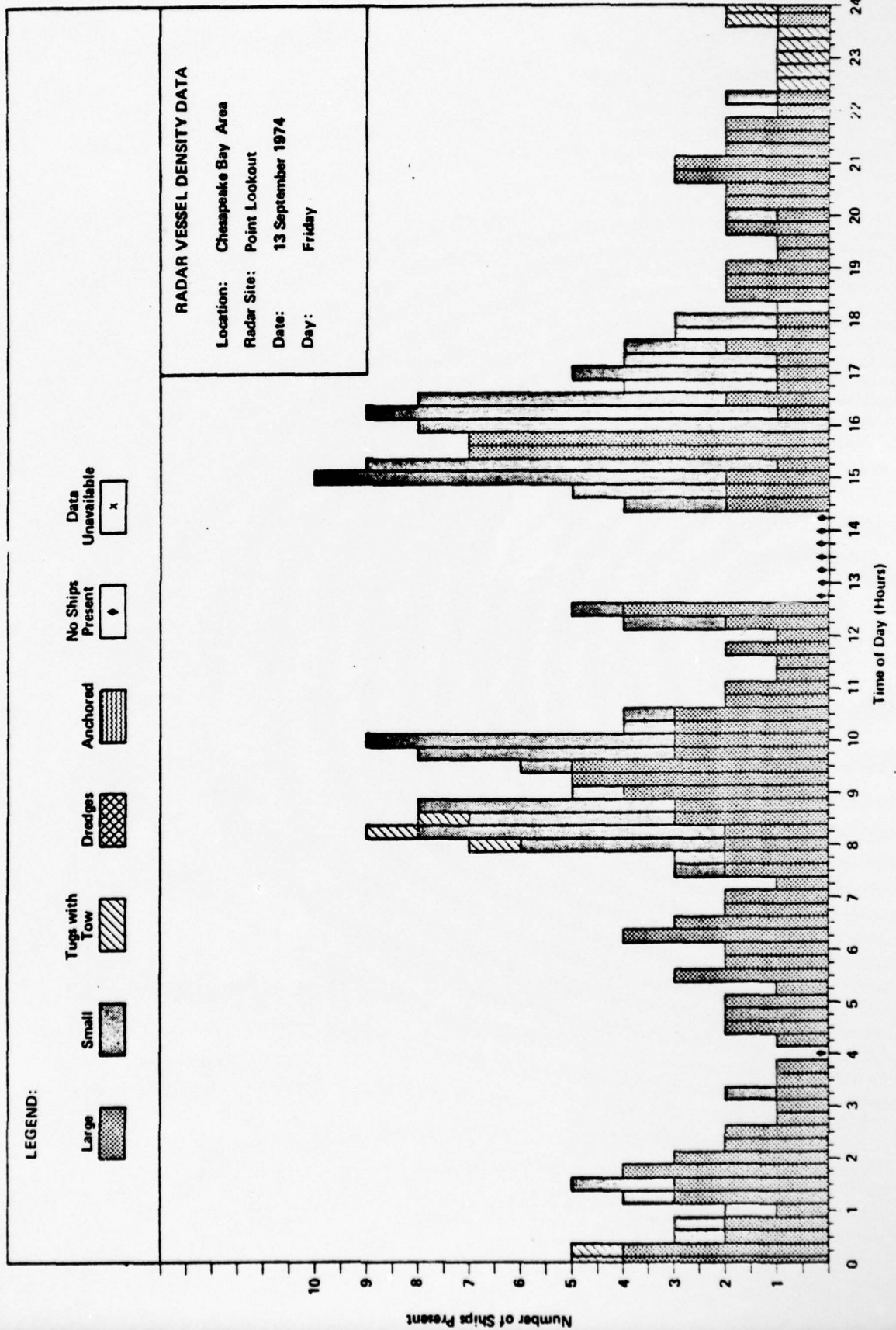


RADAR VESSEL DENSITY DATA

Location: Chesapeake Bay Area
 Radar Site: Point Lookout
 Date: 11 September 1974
 Day: Wednesday





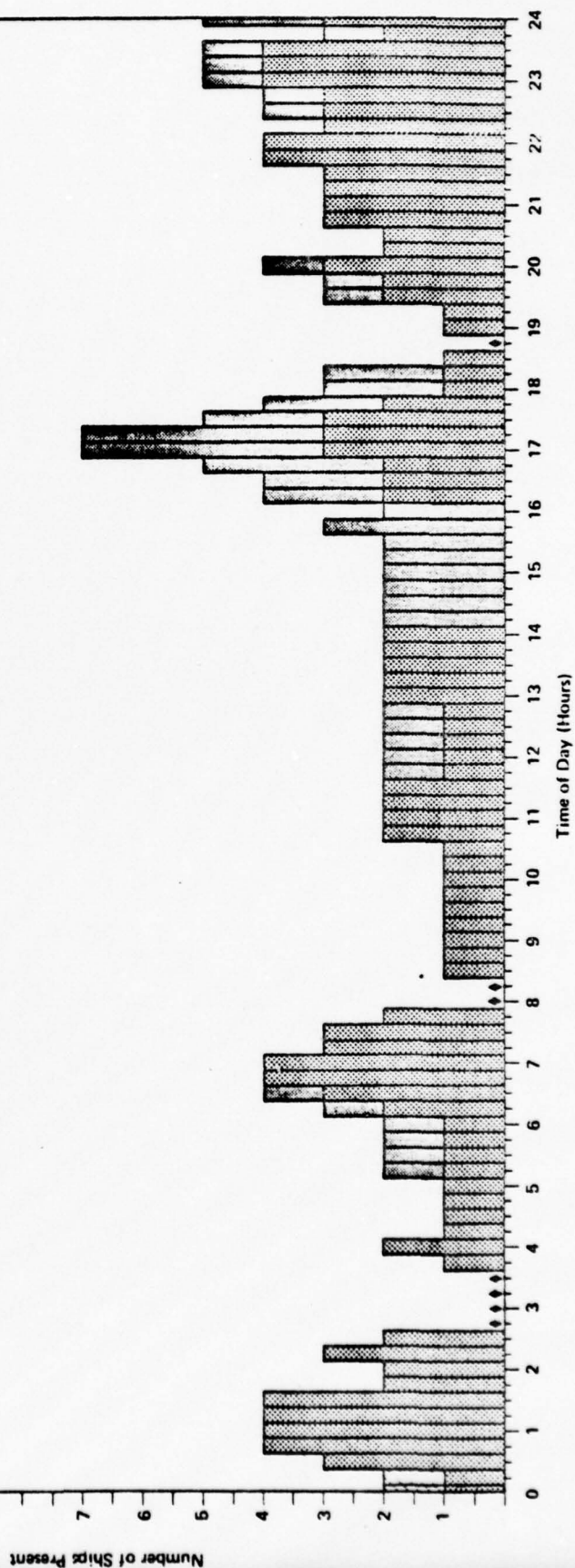


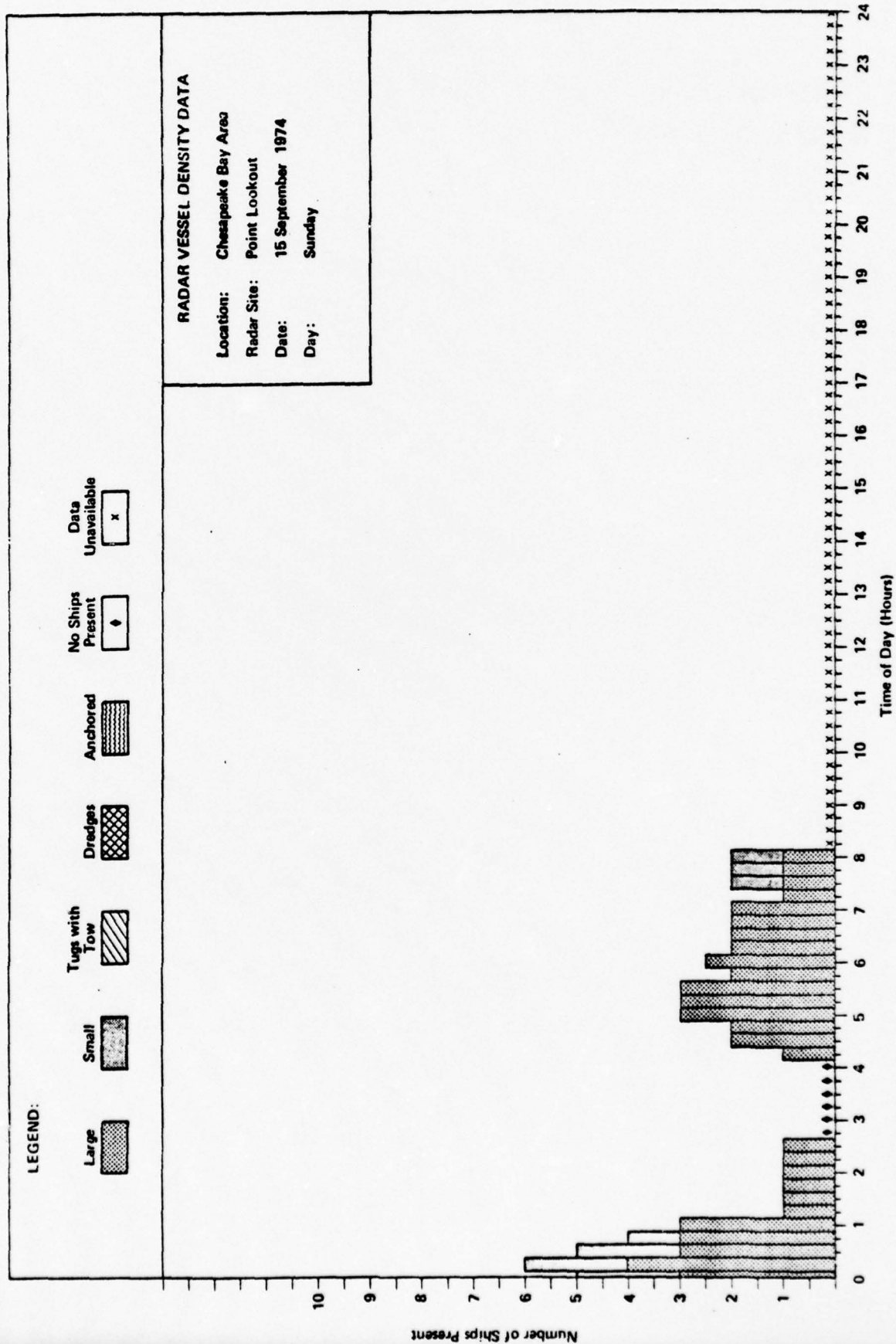
LEGEND:



RADAR VESSEL DENSITY DATA

Location: Chesapeake Bay Area
 Radar Site: Point Lookout
 Date: 14 September 1974
 Day: Saturday





RADAR VESSEL SPEED DATA

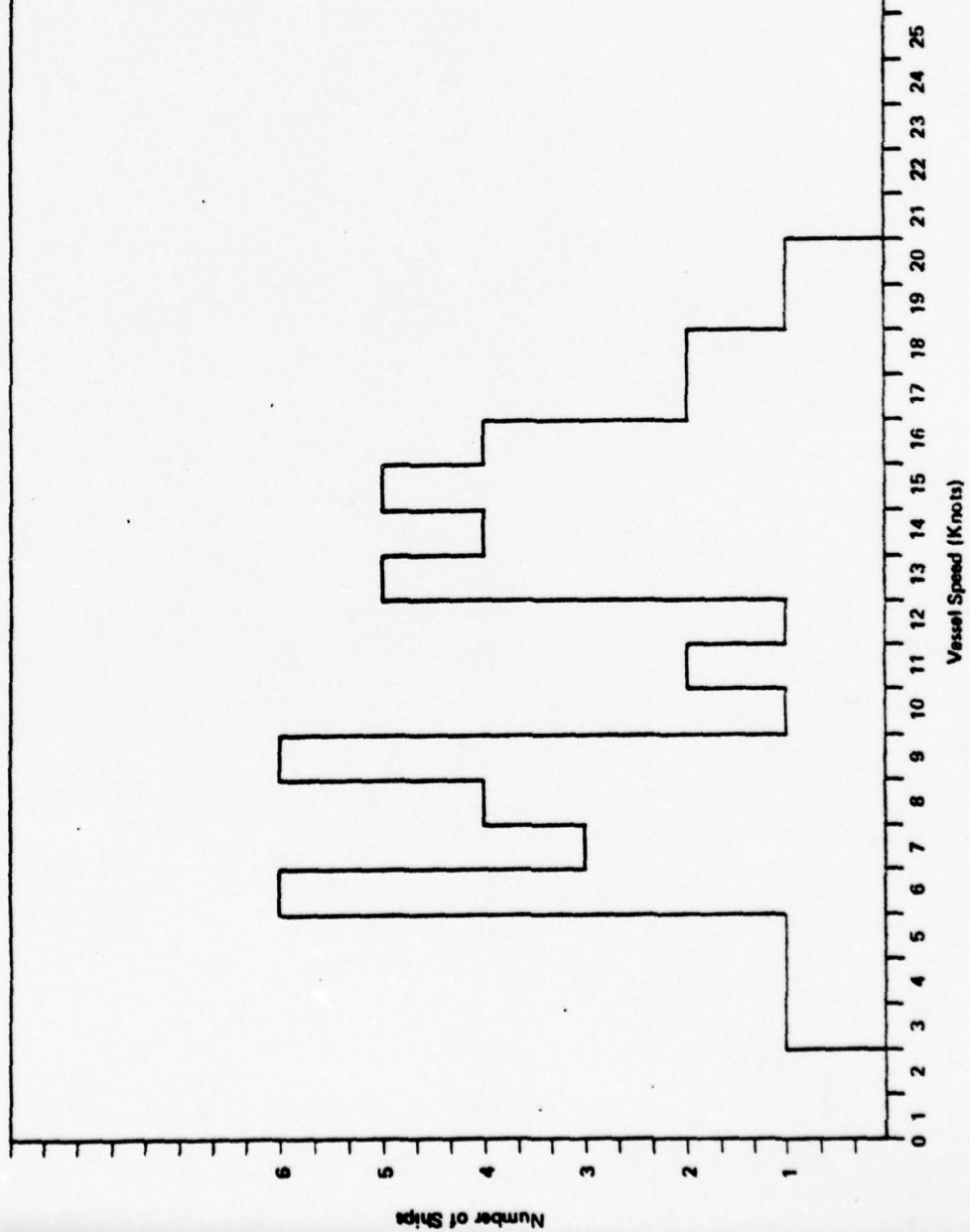
Location: Chesapeake Bay Area

Sample Size: 50

Radar Site: Point Lookout

Date: 13, 14 September 1974

Day: Friday and Saturday



SPEED DATA
FOR
POINT LOOKOUT

Vessel No.	Vessel Size	Average Speed in Knots	Location*	Direction	Day	Time Hour/Minute	
1	large	15	C	South	13 September 1974 Friday	07	33
2	large	20	C	South		07	50
3	large	14	C	North		08	27
4	small	8	P	NW		08	45
5	small	8	P	NW		08	55
6	large	15	C	North		09	15
7	large	16	C	North		14	30
8	small	8	C	West		15	49
9	small	7	C	South		15	49
10	large	6	C	North		15	49
11	large	16	P	SE	14 September 1974 Saturday	16	20
12	large	13	P	SE		16	25
13	large	7	C	South		16	34
14	small	13	C	South		16	35
15	large	17	C	South		17	52
16	large	13	C	South		18	23
17	large	13	C	South		19	44
18	large	15	C	South		20	04
19	large	16	C	South		20	45
20	large	18	C	North		21	17
21	tug with tow	6	C	North		22	43
22	large	14	C	South		23	20
23	large	14	C	South		00	07
24	tug with tow	5	C	South		00	19
25	large	11	C	North		01	52
26	large	6	P	NW		03	35

*C = Chesapeake Bay
P = Potomac River

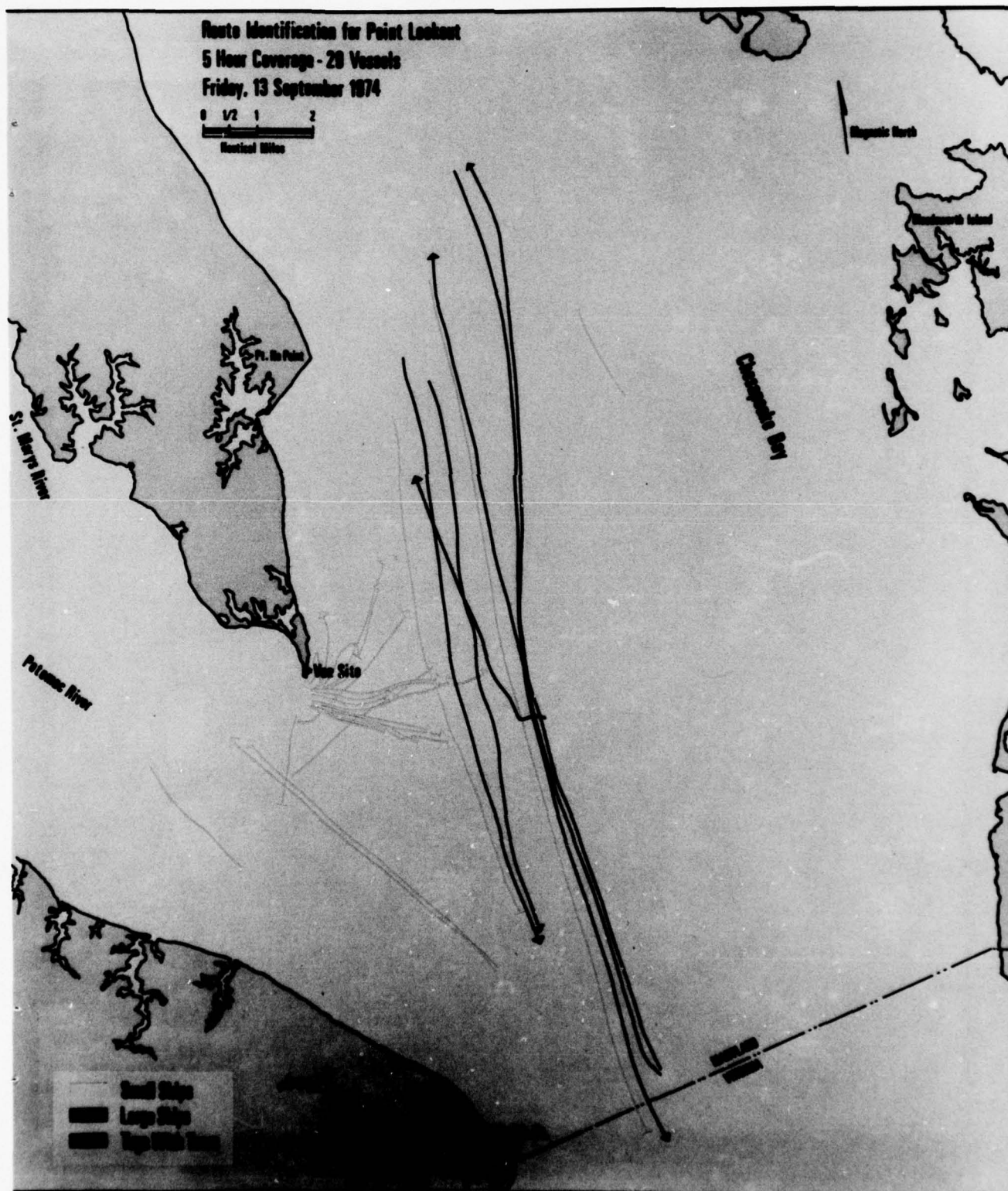
SPEED DATA
FOR

POINT LOOKOUT (Cont)

Vessel No.	Vessel Size	Average Speed in Knots	Location*	Direction	Day	Time Hour/Minute
27	large	15	C	South	14 September 1974 Saturday	03 49
28	large	4	C	North		04 46
29	large	6	C	North		05 35
30	large	13	C	North		06 09
31	large	19	C	South		06 05
32	large	14	C	South		07 13
33	small	8	P	SE		07 25
34	small	10	C	East		08 04
35	tug with tow	3	C	North		08 53
36	tug with tow	9	C	North		10 16
37	large	9	C	South		11 02
38	large	12	C	North		11 48
39	small	18	P	SE		12 36
40	large	16	C	North		12 41
41	small	9	C	North		12 56
42	small	6	C	South		14 34
43	small	9	C	South		14 34
44	small	7	C	South		14 52
45	large	9	C	North		15 20
46	large	9	C	South		16 20
47	large	6	P	NW		16 25
48	large	11	C	North		16 41
49	large	17	C	South		17 05
50	large	15	C	North		18 53

*C = Chesapeake Bay
P = Potomac River

0 1/2 1 2
Nautical Miles



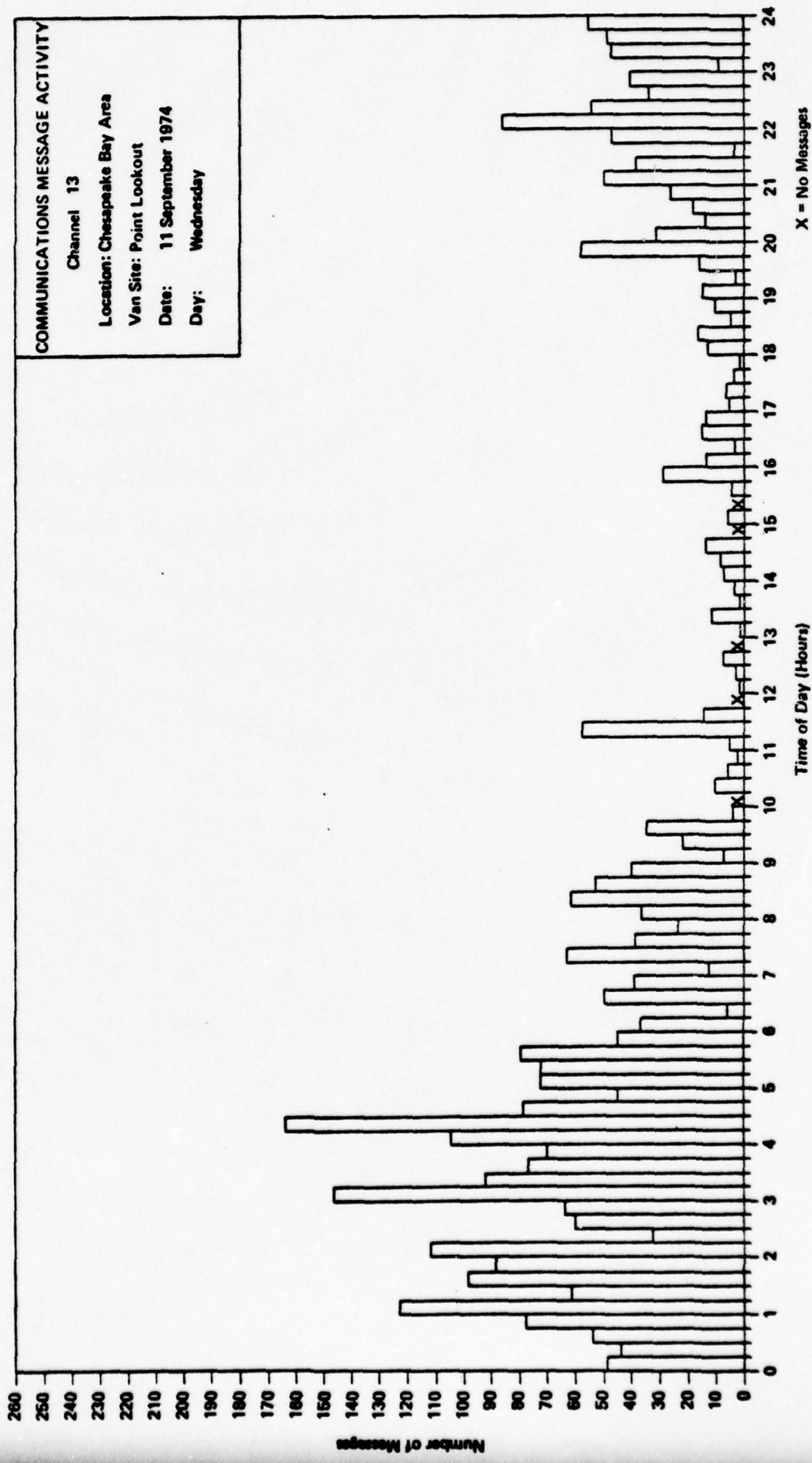
CLOSE ENCOUNTER DATA
FOR
POINT LOOKOUT

No.	Day	Time Hour/Minute		Distance Yards	Size	Manner of Approach*
1	Friday 13 September 1974	08	42	<90	1 tug, 1 small	O
2		09	46	<90	2 small	P
3		11	04	180	2 small	O
4		11	07	400	2 small	O
5		14	54	180	2 small	O
6		14	57	190	2 small	P
7		15	09	230	2 small	P
8		15	11	180	2 small	O
9		15	14	<85	2 small	P
10		15	14	<85	2 small	P
11		15	14	<85	2 small	O
12		15	15	190	2 small	P
13		15	43	<85	2 small	O
14		16	00	180	2 small	P
15		16	06	400	2 small	P
16		16	15	230	2 small	P
17		16	26	<90	2 small	O
18		21	21	400	2 large	P
19	Saturday 14 September 1974	08	23	220	2 small	O
20		08	54	240	1 large, 1 small	C

20 close encounters out of 100 encounters
during a 24-hour period.

*P = Passing
O = Overtaking
C = Crossing

< = less than



COMMUNICATIONS CHANNEL EFFICIENCY

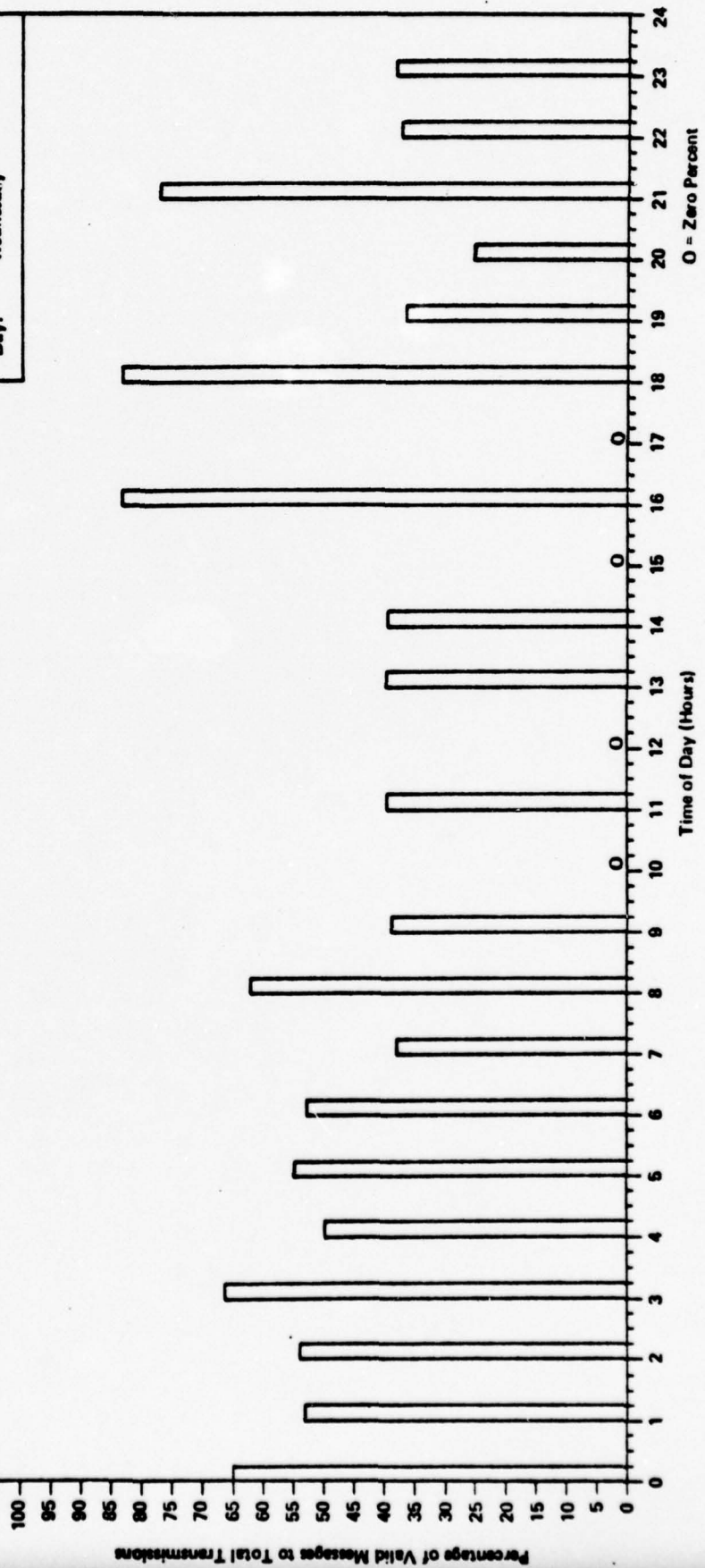
Channel 13

Location: Chesapeake Bay Area

Van Site: Point Lookout

Date: 11 September 1974

Day: Wednesday



COMMUNICATIONS CHANNEL
UTILIZATION

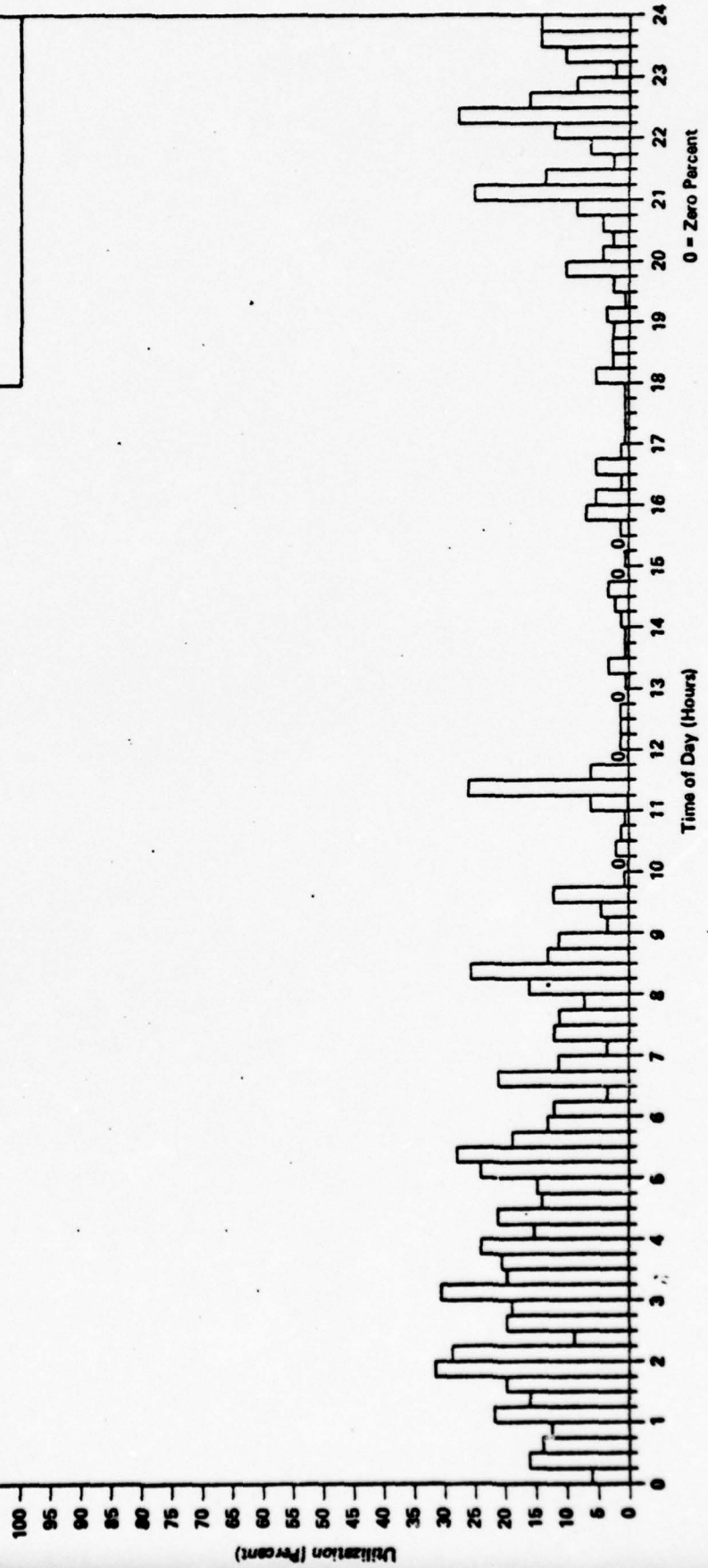
Channel 13

Location: Chesapeake Bay Area

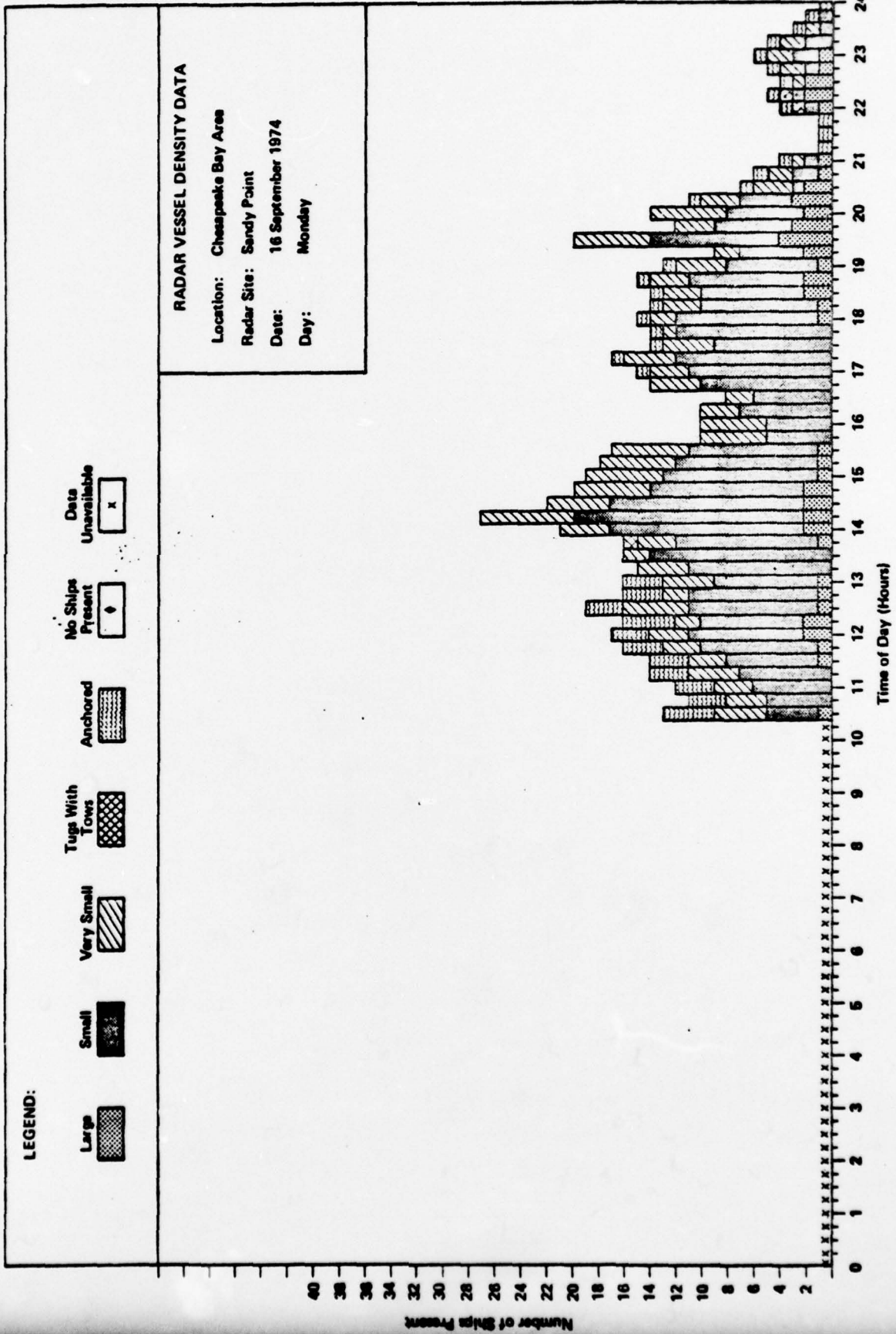
Van Site: Point Lookout

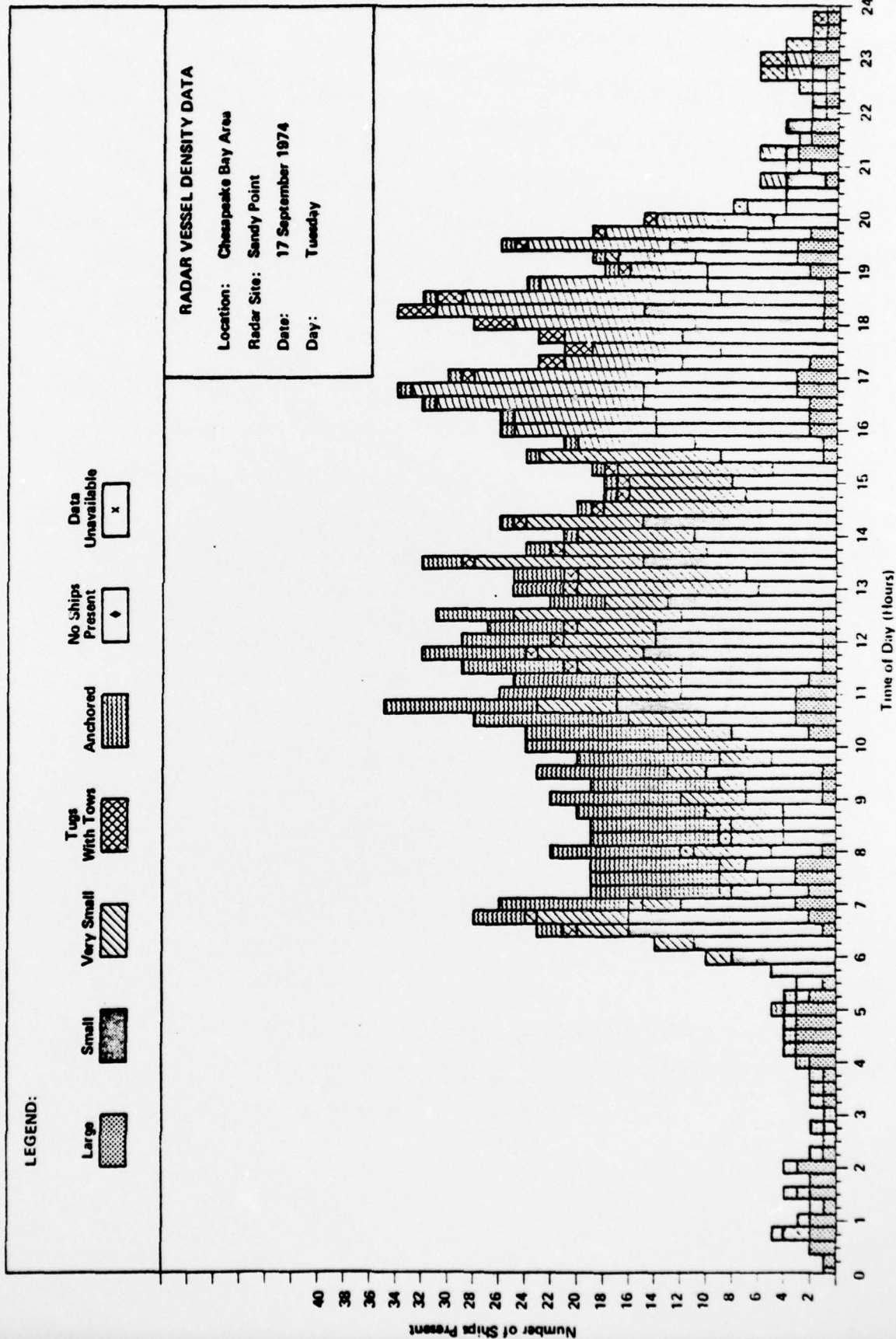
Date: 11 September 1974

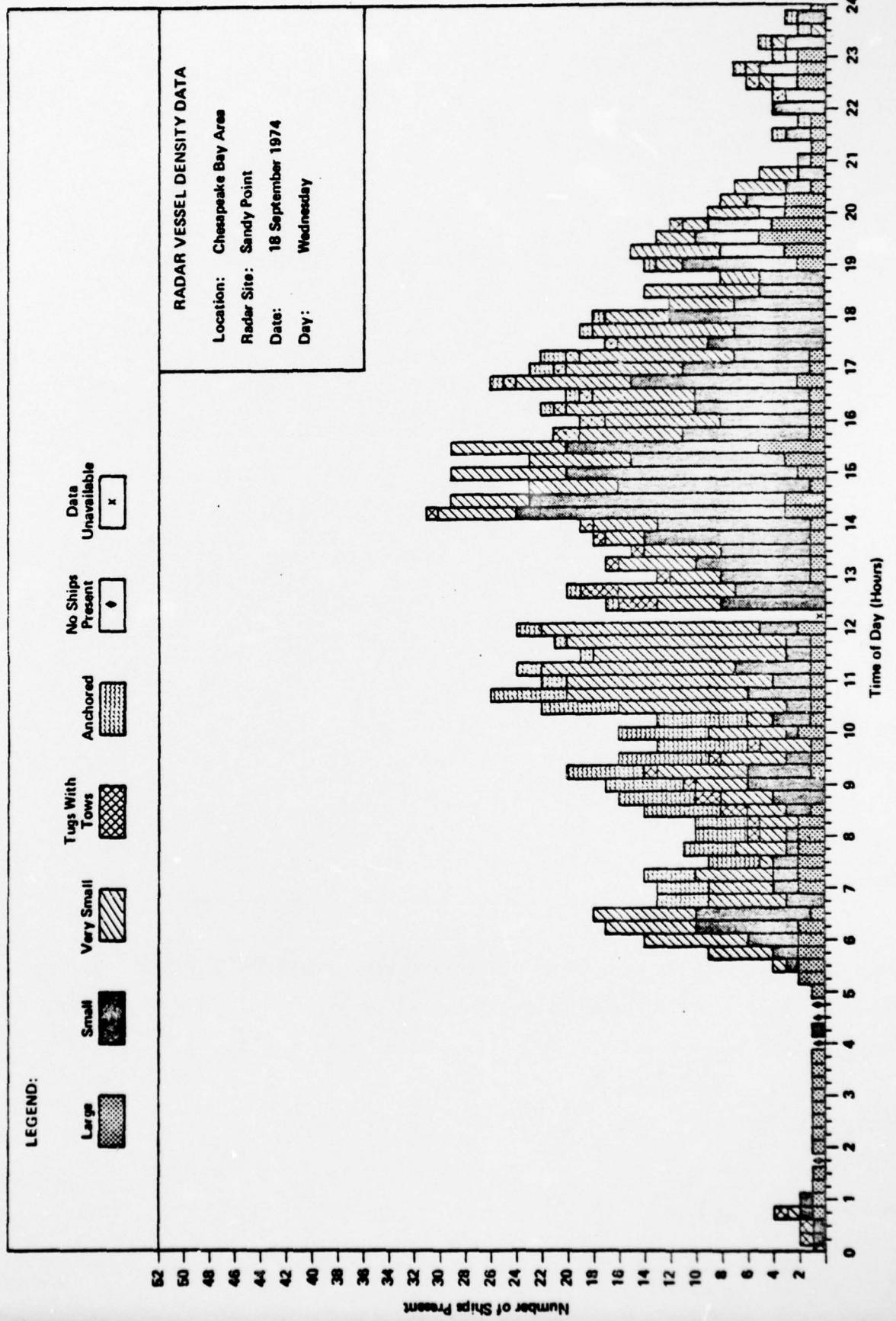
Day: Wednesday

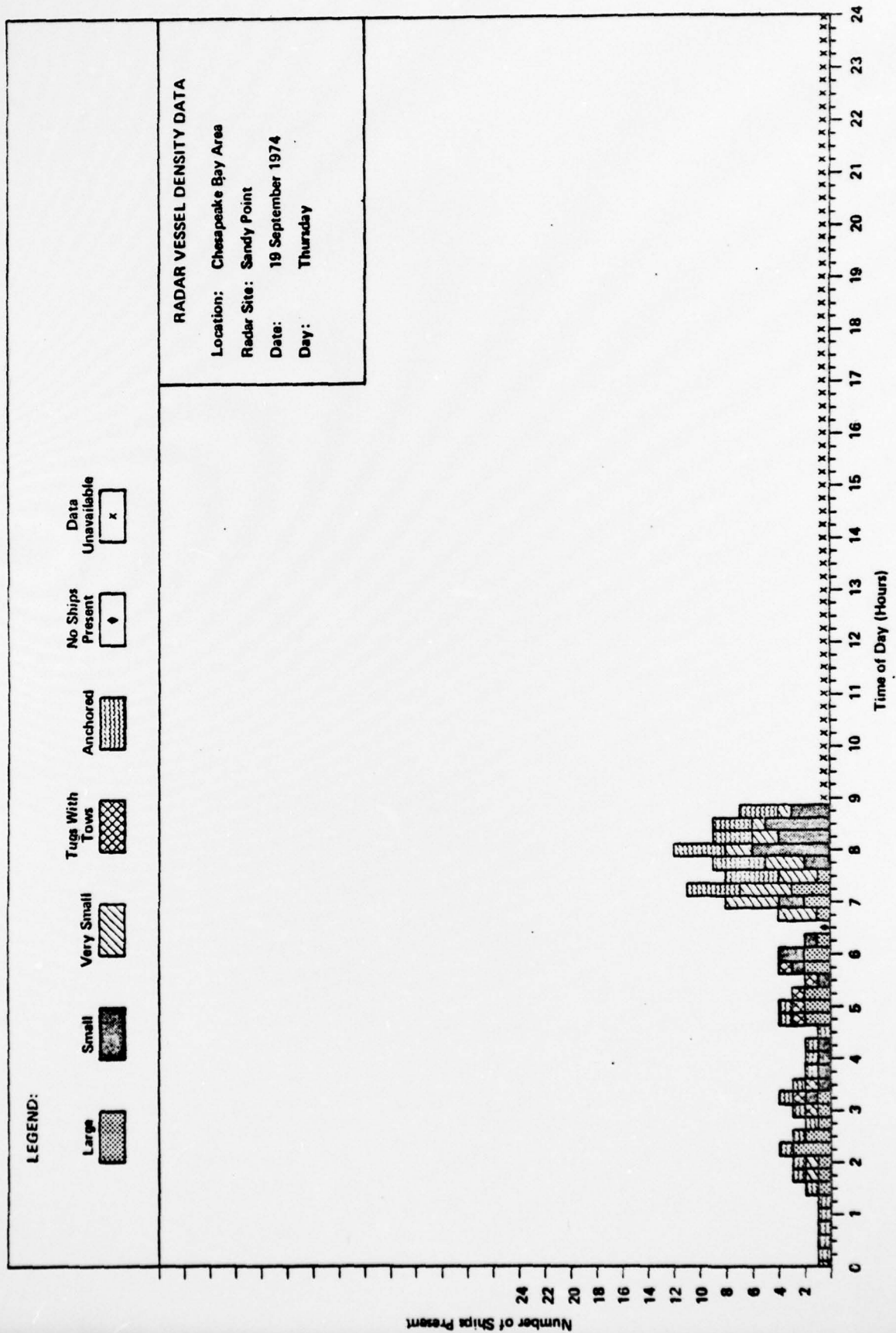


2.6 DATA FROM SANDY POINT









RADAR VESSEL SPEED DATA

Location: Chesapeake Bay Area

Sample Size: 67

Radar Site: Sandy Point

Date: 17, 18 September 1974

Day: Tuesday and Wednesday



SPEED DATA
FOR
SANDY POINT

Vessel No.	Vessel Size	Average Speed in Knots	Location*	Direction	Day	Time Hour/Minute	
1	large	8	B	North	17 September 1974 Tuesday	10	31
2	large	15	A	North		10	33
3	small	12	B	South		10	40
4	large	3	B	North		10	48
5	small	9	A	South		10	52
6	small	10	B	South		11	19
7	large	11	A	North		11	29
8	large	10	A	North		11	47
9	large	10	A	North		11	51
10	large	11	A	North		12	10
11	tug with tow	7	A	North		12	45
12	small	5	B	South		13	07
13	tug with tow	8	A	North		13	12
14	small	4	B	South		13	23
15	small	11	A	South		13	56
16	tug with tow	13	A	South		14	17
17	small	11	B	South		14	19
18	tug with tow	14	B	South		14	36
19	large	12	A	North		14	45
20	large	12	A	North		15	02
21	large	9	B	South		15	55
22	large	6	A	North		15	58
23	small	16	B	South		16	15
24	small	11	A	North		16	20
25	small	18	B	North		16	21
26	large	11	B	South		16	26
27	large	6	A	North		16	33

*A - Craighill Channel
B - Central Bay

SPEED DATA
FOR
SANDY POINT (CONT)

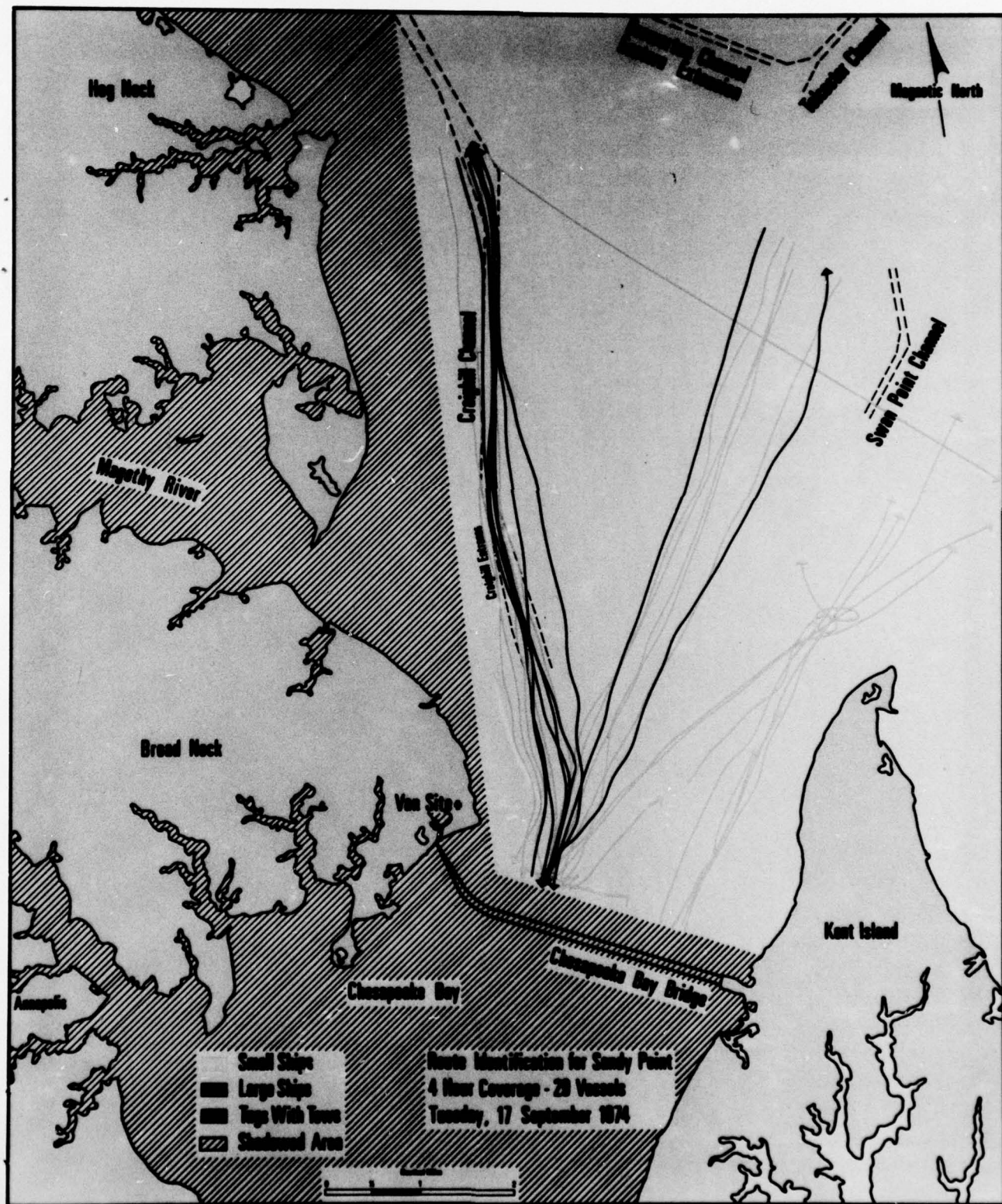
Vessel No.	Vessel Size	Average Speed in Knots	Location*	Direction	Day	Time Hour/Minute	
28	small	11	A	North	17 September 1974 Tuesday	16	39
29	large	6	A	South		18	00
30	tug with tow	12	A	South		18	01
31	tug with tow	12	B	South		18	22
32	large	5	B	South		18	45
33	large	10	A	South		18	53
34	small	19	B	South		19	10
35	large	10	B	South		19	18
36	large	11	A	North		21	11
37	large	5	B	North		21	22
38	large	12	A	North		21	28
39	small	8	B	North		22	06
40	tug with tow	8	B	North		22	16
41	tug with tow	4	A	North		22	39
42	large	8	A	South		22	59
43	large	9	B	South	18 September 1974 Wednesday	23	30
44	tug with tow	4	A	North		23	32
45	large	7	A	South		00	41
46	large	8	B	South		01	15
47	large	12	A	South		01	57
48	large	13	B	South		02	17
49	large	12	A	South		02	33
50	large	12	B	South		02	54
51	large	11	A	North		02	58
52	large	9	A	North		03	17
53	large	13	A	North		04	51
54	large	14	A	North		05	06

*A = Craighill Channel
B = Central Bay

SPEED DATA
FOR
SANDY POINT (CONT)

Vessel No.	Vessel Size	Average Speed in Knots	Location*	Direction	Day	Time Hour/Minute	
55	large	9	B	North	18 September 1974 Wednesday	06	50
56	small	8	B	South		07	29
57	small	9	B	South		07	40
58	tug with tow	8	B	South		08	10
59	tug with tow	7	B	North		08	15
60	small	6	B	South		08	19
61	tug with tow	9	B	South		08	21
62	small	8	B	South		08	33
63	tug with tow	5	B	South		08	48
64	small	9	B	South		08	52
65	small	10	B	South		09	02
66	small	12	B	North		10	52
67	small	7	B	South		10	53

*A = Craighill Channel
B = Central Bay



CLOSE ENCOUNTER DATA
FOR
SANDY POINT

No.	Day	Time Hour/Minute		Distance Yards	Size	Manner of Approach*
1	Tuesday 17 September 1974	13	00	280	2 small	P
2		13	03	120	2 small	P
3		13	06	150	2 small	O
4		13	08	<100	2 small	P
5		13	10	210	2 small	O
6		13	14	<100	2 small	O
7		13	18	<90	2 small	O
8		13	18	110	1 tug, 1 small	P
9		13	21	180	1 tug, 1 small	C
10		13	24	120	2 small	P
11		13	31	100	2 very small	P
12		13	35	130	2 small	P
13		13	38	<80	1 very small, 1 small	P
14		13	39	200	2 small	C
15		13	42	140	2 small	C
16		13	47	210	2 small	P
17		13	50	110	2 small	P
18		13	53	130	2 small	P
19		13	53	<60	2 small	O
20		13	55	<100	2 small	P
21		13	55	<100	2 small	C
22		13	55	<100	2 small	C
23		13	55	<100	2 small	P
24		13	55	<100	2 small	C
25		13	55	<100	2 small	C
26		13	56	<100	2 small	P
27		13	57	220	2 small	O
28		13	59	180	2 small	P

*P = Passing
O = Overtaking
C = Crossing

< = less than

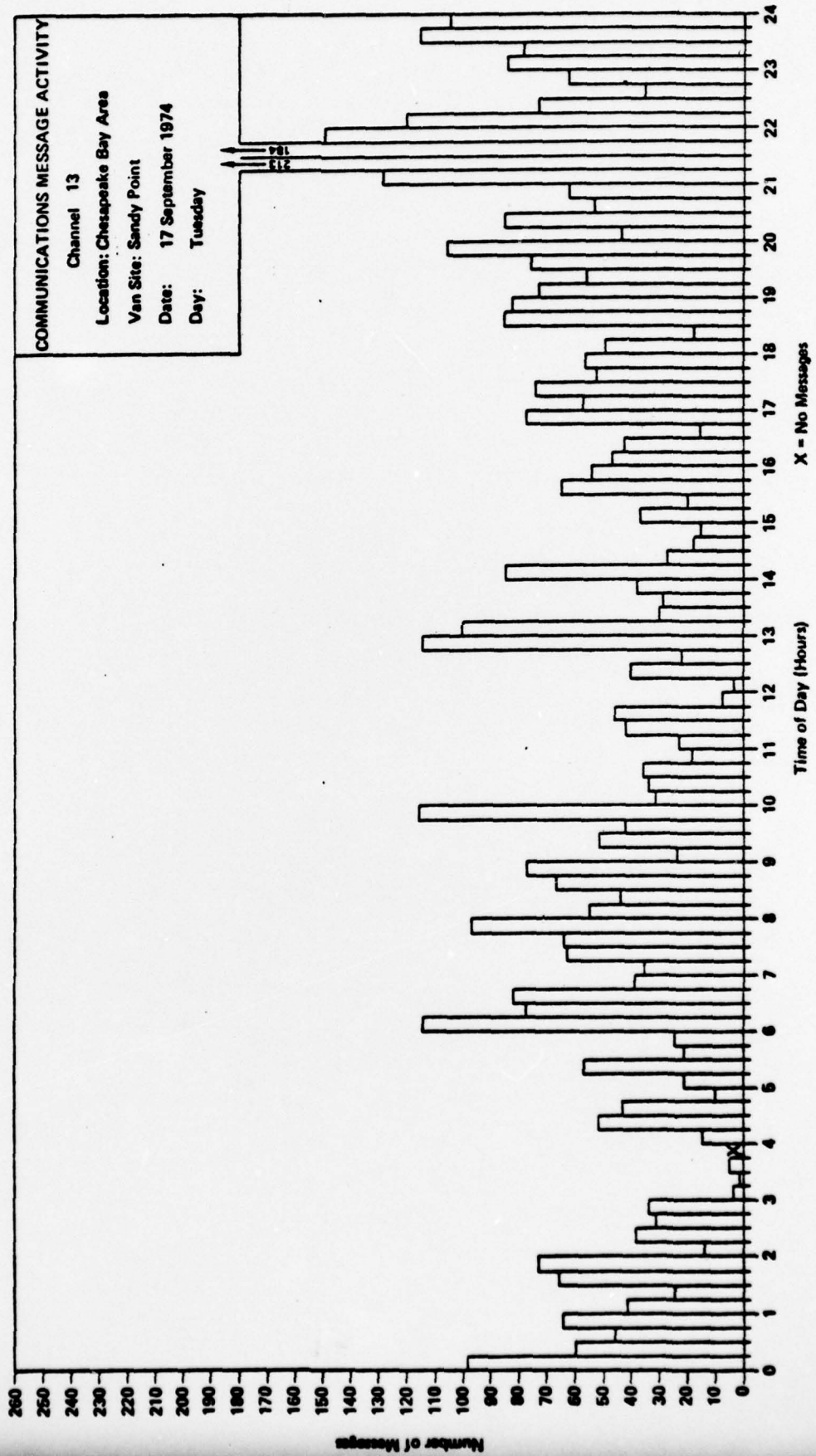
CLOSE ENCOUNTER DATA
FOR
SANDY POINT (CONT)

No.	Day	Time Hour/Minute		Distance Yards	Size	Manner of Approach*
29	Tuesday 17 September 1974	14	00	<100	2 small	P
30		14	02	<100	2 small	P
31		14	02	130	2 small	P
32		14	05	200	2 small	O
33		14	06	<110	2 small	P
34		14	11	180	2 small	P
35		14	13	<100	2 small	O
36		14	15	190	2 small	C
37		14	17	170	2 small	P
38		14	18	200	2 small	P
39		14	19	150	2 small	P
40		14	29	210	1 tug, 1 small	P
41		14	41	<100	2 small	C
42		14	43	240	2 small	P
43		14	48	200	2 large	P
44		14	51	<100	2 small	P
45		14	51	<100	2 small	P
46		14	51	<100	2 small	O
47		14	52	230	2 small	O

47 close encounters out of 92 encounters
during a two-hour period.

*P = Passing
O = Overtaking
C = Crossing

< = less than



COMMUNICATIONS CHANNEL EFFICIENCY

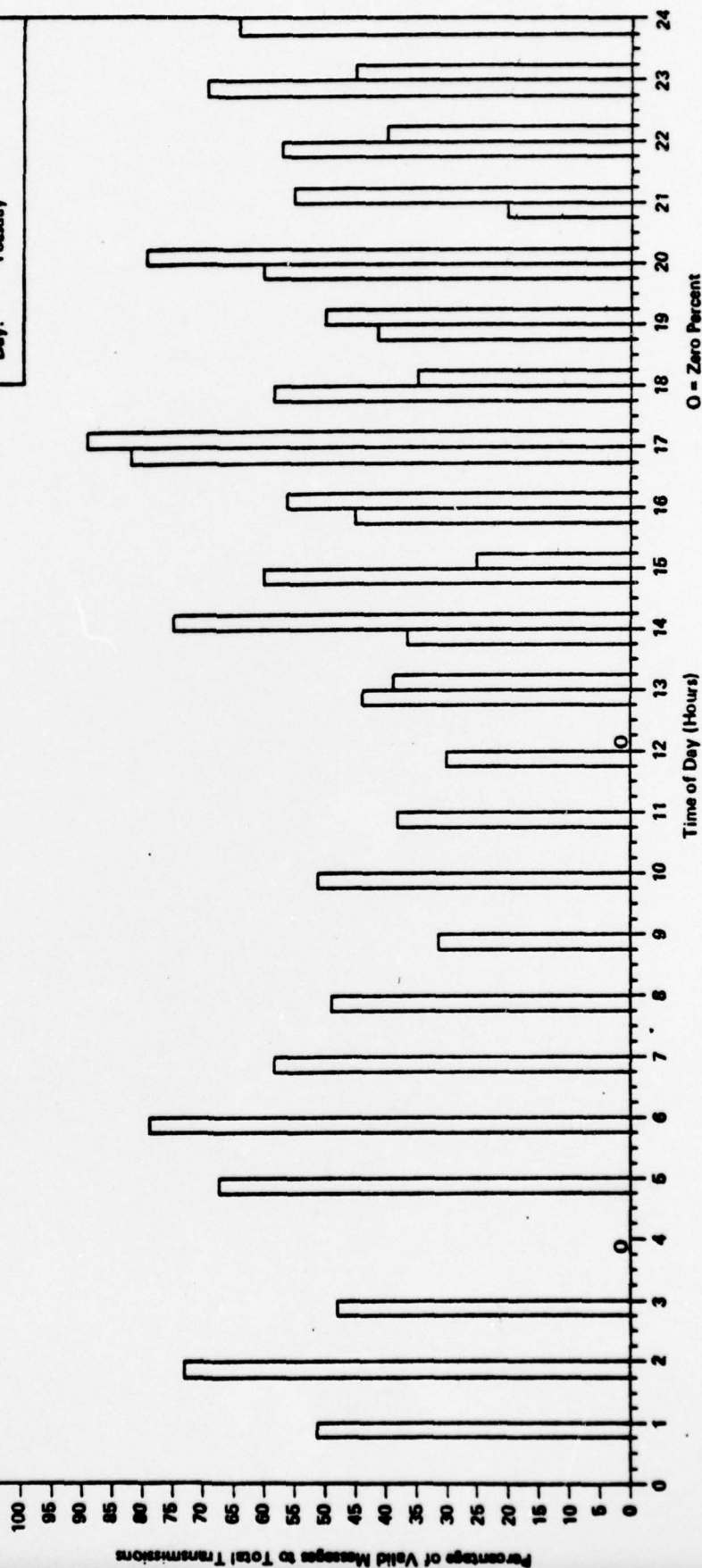
Channel 13

Location: Chesapeake Bay Area

Van Site: Sandy Point

Date: 17 September 1974

Day: Tuesday



COMMUNICATIONS CHANNEL
UTILIZATION

Channel 13

Location: Chesapeake Bay Area

Van Site: Sandy Point

Date: 17 September 1974

Day: Tuesday

